

TOPICS OF THE MONTH

Royal Charter for Institution of Chemical Engineers

THE grant of a Royal Charter to the Institution of Chemical Engineers reflects the importance attached to chemical engineering today and cannot but add to the high esteem in which the profession is already held. This latest development must be regarded as the crowning achievement of the body of industrialists, chemists and engineers who came together to found the Institution in 1922, and of those who have carried on the good work since.

The Institution came into being because it was found that the design and operation of chemical plant needed its own engineering discipline, but there was no splitting off from other professional institutions, who were all consulted about the new foundation. Agreement was general that a new qualifying professional body alone could organise the study of the new technology. The qualifying activities of the Institution are still of first importance, though the task of examining students is lightened by the growth of degree, diploma and postgraduate courses in chemical engineering in the universities and colleges of technology and by the courses for the higher national certificate.

The membership of the Institution has grown steadily, so that today the number has risen to 3,500 from 880 in 1936. The extension of the Institution's influence to the Commonwealth is also to be noted and there is a strong branch in South Africa and advisory panels operating in Australia, India and New Zealand. The status of the Institution in Europe was acknowledged when, through the Department of Scientific and Industrial Research, an invitation was issued to organise a conference on the 'Functions and Education of the Chemical Engineer' under the auspices of the O.E.E.C.

A number of other conferences and symposia organised by the Institution have attracted considerable attention, the latest being the symposium recently held at Birmingham University, of which an account is given in this issue. Such activities as these, along with the impetus the Institution gives to educational progress, are much to the ultimate benefit not only of the Institution's members, but also of industry and the country at large.

Chemical processing of irradiated fuel

A NUMBER of O.E.E.C. working parties have been considering various aspects of European co-operation on atomic energy under the Steering Committee for Nuclear Energy set up by the decision of the Council of Ministers on July 18, 1956. Among the more important subjects under consideration is

that of a joint chemical separation plant, and a study group has recommended that, as a first step, a small plant with a capacity of 50 tons p.a. should be built by 1960 for processing uranium up to medium enrichment. It would both provide processing capacity adequate for Continental Europe's immediate needs and serve as a pilot project for larger plants later on.

The United Kingdom is willing to provide advice and help (where appropriate on commercial terms), but will not participate in the pilot plant because its own capacity will be more than adequate for its immediate needs.

The U.K. has not committed itself as regards participation in a major plant.

Chemicals and manpower in the U.S.

IN discussing the shortage of chemical engineers in Britain and other parts of Europe, comparisons are often made with Russia and the United States and it is not always realised that in the latter country, at least, there is a shortage which is regarded just as seriously. The American chemical industry has been pressed to review its policies regarding personnel to avoid manpower shortage between now and 1967 and a U.S. Labour Department official told a meeting of the American Institute of Chemical Engineers recently that the continued emphasis on research and development, and the greater complexity of chemical products and processes, are expected to give rise to 'disproportionately' rapid increases in demands for chemists, chemical engineers and technicians within eight years.

This will mean the industry taking account of the change in American manpower trends in the coming years. Of an expected increase of 10 million in the number of workers, about 5 million will be men, half of whom will be under 24 years of age. The American chemical industry will have to place greater emphasis on testing, placement and on-the-job training if it expects to tap this willing but inexperienced manpower pool.

Controlling boredom in the control room

EVEN in the petroleum and chemical industries, which have long been ahead of other industries in the application of automatic controls, more and more processes and operations are becoming automatic but still require some form of supervision, so that there will be an increasing number of industrial workers who find themselves in the position of sentries, or pilots on long-distance flights. Where there is nothing to do but to hang about watching dials or waiting for audible signals the danger of boredom presents itself and a recent editorial in *Automation Progress* (one of

the Leonard Hill Technical Group of publications) makes some interesting comments on this growing problem and considers how it can be minimised.

In many cases, it would seem, the short answer is more and better automation. Just as monotonous muscular activity is most easily replaced by an automatic machine, so monotonous reading of dials or taking of samples can be done with the aid of data logging and scanning systems. There remains the all-important question of general supervision, particularly with regard to the timely prevention of accidents in emergencies.

If a man must spend his entire working day in a control room waiting for alarm signals, it must be made possible for him to occupy himself usefully in other directions, without any danger of missing the alarm. Our associate journal points out that the latter task is perhaps the easiest to tackle; it depends mainly on the intelligent design of alarm systems. Where there are several bells ringing or lights flashing in various parts of the room, only some of which call for serious action, the system defeats its own purpose. Too often the warning function is confused by the designer with the indicating function which locates the trouble in a particular section of the plant. The warning signal must be situated in the immediate proximity of the operator and must be confined in use to real emergencies. The main control panels can then be used to indicate the location of faults and other, less essential, data.

Assuming, however, that the system has been intelligently designed and that the supervisor can safely detach his attention from the plant for, say, 90% of the time, it remains to occupy him, preferably, productively. This can often be arranged with the aid of a little planning, just as telephone operators who are not too busy can be employed in typing and other work.

Bright future for bright finish

A NEW, bright metal finish for industrial and domestic use is promised from experimental work now being undertaken at the Tin Research Institute at Greenford. Scientists at the Institute have found that the addition of a small quantity of wood tar to solutions used in tin plating causes the tin coating to be deposited as a bright finish. While this new application is still in the laboratory stage, results to date were described at the spring conference of the Institute of Metal Finishing, at Brighton, in a paper by Mr. S. C. Britton, Mr. A. M. Harper and Mr. A. Mohan. Experiments are still going on to discover the constituent of the tar which causes this bright finish, but sufficient results have been obtained to show that the bright plating process is a practical proposition.

Electrical equipment and instrument parts are among the products which would benefit especially from the new process. This attractive finish, when in commercial production, seems likely to challenge bright finishes of other metals in such fields.

Heat transfer and distillation column design

IN a new approach to fractional distillation as applied to the engineering design of plate columns, calculation of the number of plates is based on a heat transfer instead of a mass transfer rate function. Thus a weakness of the method that is more commonly used—absence of reliable general methods for estimating efficiencies—is avoided and the new method seems to hold out a hope of greater accuracy in design work.

It is obviously an advantage to reduce over-design or under-design, especially from the economic point of view. The heat-transfer approach has been the subject of experiments at the Department of Chemical Engineering, State College of Washington, U.S., by H. Stern, P. G. Deshpande and S. A. Murdock (*Trans. Ind. Inst. Chem. Engrs.*, 1955-56, 8 (1), 6), who explain that, when the mechanism assumed involves heat transfer rather than mass transfer, the driving force is temperature rather than concentration difference. Experimental work was carried out on five binary systems and it was shown that the heat-transfer-rate function, defined in terms of liquid and vapour temperatures, may be somewhat more correlatable with vapour velocity and physical properties than is the mass-transfer-rate function. It was also shown that physical properties of mixtures can vary considerably with composition, in contrast with the heat-transfer or mass-transfer-rate functions which remain fairly constant with composition.

Evidence was presented to show that the ratio of the physical properties of the pure components may be more significant than the physical properties of the mixture of the components.

Electricity and costs

ELECTRICAL plant in factories is broadly of two types—that required to bring the electricity to the point where it is to be used and that required to turn it into mechanical work, heat or chemical action for the productive process. The actual physical layout and arrangement of plant, particularly on continuous processes, can influence not only the ease of installation and maintenance but also the actual cost.

These and other aspects of the selection, installation and maintenance of electrical plant in factories will be discussed by two speakers, Sir Henry Clay and Mr. G. Ovens, at the 9th British Electrical Power Convention to be held at Eastbourne next month, and it seems that some emphasis will be thrown on economy. One point to be made is that electricity is such a convenient and easily controlled means for driving plant that one tends to think of it as having no rival, but for certain special jobs other means can be cheaper. For instance, for a particular blast furnace blower, the running costs with electricity were £30,000 a year more. As a source of heat, electricity has many uses, but special circumstances must favour it, because so much capital is required to produce electricity and so much of the original heat in the fuel has to be thrown away in condensing water.

Boron tribromide

THE announcement that British-made boron tribromide is now available in experimental quantities recalls the forecasts, made over the past year or so, of new developments in boron chemistry and the more recent news that Borax Consolidated Ltd. had set up larger research laboratories at Chessington in Surrey.

Many of the reactions of boron tribromide are similar to those of boron trichloride. There are a number of possible applications in industry; for example, as a catalyst in the isomerisation of certain paraffin and olefin hydrocarbons or in some polymerisation reactions for making synthetic rubber and high-molecular-weight resins. Boron tribromide might also be used to promote the synthesis of silicones and similar compounds.

Organoboron compounds, which are becoming of increasing interest to industry, could easily be made by using this product. It is also an effective brominating agent. Very pure elemental boron has been obtained by the action of hydrogen on boron tribromide; it is suggested that this would be suitable for electronic use. In metallurgy, boron tribromide is expected to be of value in the case-hardening of ferrous and non-ferrous metals.

Fertiliser figures

WITH the publication last month of the eighth issue of the United Nations' book of world statistics* it is revealed that in 1955 world economic activity generally reached a new post-war high point, far above the pre-war level. In that year the world's railway engines hauled more than twice as much freight, the world's ships carried about two-thirds more cargo and there were over twice as many motor vehicles on the world's roads as in 1938. Synthetic rubber consumption reached a new post-war high point in 1955, some 44% above the 1954 mark; tin consumption increased by 8% between 1954 and 1955, but still fell 6% short of the 1937 peak consumption.

It is also notable that world (excluding U.S.S.R.) consumption of fertilisers has increased rapidly during the post-war years and in 1955-56 exceeded the pre-war (1938) consumption by no less than 162% for nitrogenous fertilisers, by 144% for potash fertilisers and by 100% for phosphatic fertilisers. Consumption of fertilisers has expanded at an even more rapid rate in the United States, which in 1955-56 accounted for 32 to 33% of world (excluding U.S.S.R.) consumption of these fertilisers, against 14 to 19% in 1938.

This increase in fertiliser consumption is also confirmed in the recent O.E.E.C. report† on the fertiliser situation in Europe and the United States in 1955-56 and it is plain that, in Europe, total consumption of fertilisers rose more than production. However,

* 'Statistical Yearbook,' prepared by the Statistical Office of the United Nations. Pp. 646, 40s., from all U.N. Sales Agents, including H.M.S.O.

† Fertilisers 1954-1957, Organisation for European Economic Co-operation, Paris, 1957. Pp. 95, 8s.

the report gives figures for a new and considerable increase of the order of 15% in production of nitrogenous fertilisers in the year reviewed, and a lower rate (6%) for 1957-58. Production of potash fertilisers should again rise this year by 6% and phosphate fertilisers by only 1%.

The trend towards expanding consumption is expected to continue during the current fertiliser year also, with increases of 5% for nitrogenous fertilisers and 3% for potash and phosphate fertilisers. On the whole, however, the rate of increase, particularly for phosphates and potash, now seems to be levelling off.

Between October 1, 1955, and July 1, 1956, capacity for the production of nitrogenous fertilisers in O.E.E.C. countries increased by 8% to 3.3 million tons of nitrogen, for phosphate fertilisers there was a rise of 4% to over 4 million tons of P_2O_5 , and for potash an increase of 2% to 3 million tons of K_2O . Capacity for the production of nitrogenous and potash fertilisers is being used at a normal rate.

A large part of the capacity for the production of phosphate fertilisers, other than basic slag and the phosphoric acid components of complex fertilisers, remains idle in a number of countries.

Slide-rule for equilibrium flash calculations

A NEW equilibrium-flash slide-rule, developed by the process engineering department of the M. W. Kellogg Co., New York, now enables engineers to make flash, bubble-point and dewpoint calculations in less time than is required for present mathematical procedures. The slide-rule is based on a newly developed method which converges towards the final solution more rapidly than the conventional calculation routine. The new slide-rule makes it possible to cover in a simple way a wide range of percentage vapour and equilibrium constant values without losing accuracy.

Calculations may be started with any arbitrarily assumed value of the percentage vaporisation using the slide-rule. Succeeding equilibrium flash trials can then quickly be made until the final solution is reached. The essence of the method is that trial values to be assumed are automatically derived from the discrepancies found as results of preceding trials.

More about mercury cells

SPECIALLY designed mercury cells for the production of chlorine and caustic soda by the electrolysis of hydrochloric acid are in the news nowadays. Last month we referred to the Italian mercury cells to be installed at the chemical plant of Diamond Alkali Co. in Texas, while in Britain we have recently seen the completion of expansions at the Cheshire works of the Murgatroyd Salt & Chemical Co. Ltd. (described in CHEMICAL & PROCESS ENGINEERING for January 1957) which involved the installation of an advanced type of Uhde mercury cell.

Caustic soda of a high standard of purity is produced, too, by the Mathieson mercury cells used in the Olin Mathieson Chemical Corporation's plant at

McIntosh, Alabama, where an \$8-million expansion was recently put into operation. Built on the McIntosh salt dome to serve the needs of the rayon, paper, textile and other industries in the Deep South, the plant is at present able to produce about 250 tons/day of chlorine and 280 tons/day of caustic. To produce these chemicals from the brine pumped out of wells drilled into the salt deposit, the McIntosh plant employs 252 Mathieson mercury cells.

The operation of the cell is fairly simple. A stream of purified salt brine is piped continuously into the cell body, where it flows between a graphite anode and a moving bed of mercury which serves as a cathode. An electric current passing from the anode, through the brine, to the cathode causes the salt in the brine to break down into chlorine and sodium.

Chlorine is piped from the top of the cell to chlorine-purifying and liquefying equipment. The metallic sodium is picked up by the mercury flowing through the bottom of the cell, which carries it to a point where it is reacted with water to form caustic soda (sodium hydroxide).

The total investment of mercury in the McIntosh plant is about \$2½ million. Electricity used by the plant when it is operating at full capacity is about 1 million kwh./day.

High hopes for new pickle liquor recovery process

THE double problem confronting steelmakers of disposing of waste from pickle liquor processes and of recovering some of the sulphuric acid used in the process is one which has been given attention by chemists and engineers in a number of countries, and various processes have been developed which have provided an answer to a greater or less extent. One undoubted stroke of ingenuity was the devising of a method, described in *CHEMICAL & PROCESS ENGINEERING* for October 1955, which had been developed by the British Iron and Steel Research Federation, for treating the iron sulphate pickle liquor so that it is converted into iron oxide and fresh sulphuric acid.

A different approach can be seen in the recovery process developed by Othmar Ruthner of Austria about eight years ago and now being carried on by Blaw-Knox in the United States. The company has spent three years since acquiring the process rights putting the methods through laboratory- and bench-scale trials. Now it is reported as being in its final development stage at a pilot plant at Niles, Ohio, for recovery of 650 tons p.a. of sulphuric acid.

The Ruthner process is described as being basically simple. Pickle liquor slurry (ferrous sulphate plus sulphuric acid) is continuously removed from the pickling bath. The sulphate becomes chloride *via* hydrogen chloride gas, and is separated from the sulphuric acid in a centrifuge. Separated chloride is roasted to iron oxide—pure enough to be recharged to a blast furnace. Meanwhile sulphuric acid, along with roasting gases, cycles to a 'degassing tower.' There hydrogen chloride is stripped and absorbed in

21% hydrochloric acid. Chloride-free sulphuric acid is pumped back to the pickle bath. Absorbed hydrochloric acid, usually up to 36% HCl or so, is stripped back to 21% HCl to make hydrogen chloride gas for re-use in the process.

This process is described in *Chemical & Engineering News* for March 4, 1957, and it is stated that, according to Blaw-Knox, there is no need to add chemicals during processing, other than small amounts of make-up materials. Waste disposal is eliminated simply because there are no by-products.

Seven steel firms are sharing the cost of the Niles plant with Blaw-Knox and it is hoped that the process will be commercial within a year or so.

Algae too expensive as food source

IN recent years there has been much speculation on the possibility of obtaining large regular supplies of protein by cultivating suitable organisms called algae in tanks. Contrary to popular expectation, however, the world's growing food shortage is not likely to be relieved by the consumption of algae in the foreseeable future, according to two American chemical engineers, D. R. Thacker and H. Babcock. The reason: even under extremely favourable circumstances, algae would cost more to produce than many conventional food crops.

Large-scale cultivation of such algae as *Chlorella* has frequently been proposed as a means of averting famine in such countries as India, where production of food has failed to keep pace with population growth. Among the advantages cited for *Chlorella* is the fact that the ratio of fats and proteins in this organism can be controlled to some extent by altering the culture medium in which it is grown.

The pessimistic conclusions of the U.S. investigators are based in part upon actual production experience in a pilot plant built in New York by Chas. Pfizer & Co. Inc. Like fermentation, the breeding of *Chlorella* algae involves the care and feeding of huge tankfuls of micro-organisms.

Unfortunately, algae do not grow fast. The best yield obtained by the two scientists was 13 g. of dry algae per litre of culture fluid after a 12-day run. In comparison, normal industrial mould cultivation produces up to 50 g. of mould per litre in five days.

Many other considerations, such as regulation of light and temperature, the supply of suitable raw materials, and the processing of the end-product, conspire to increase the cost of *Chlorella* culture.

Nevertheless, they point out in the *Journal of Solar Energy, Science & Engineering*, there are three circumstances which might make the mass culture of algae a practical reality. These are an increase in world population so great as to make new sources of food mandatory regardless of cost; a major research 'break-through,' either in radically different culturing equipment, or in species of algae easier to culture than presently known types; and discovery of some valuable use for algae in addition to their use as a source of food.

Safety in Handling

CAUSTIC SODA

By N. L. Evans, B.Sc., F.R.I.C., F.I.M.

(Imperial Chemical Industries Ltd., Alkali Division)

This article contains details of precautions to be taken during the handling, transport and storage of caustic soda, concluding with some remarks on treatment of burns and eye injuries.

CAUSTIC soda is among the most important of the heavy chemicals and, while the major tonnage goes to three industries—rayon, soap and paper—it is also used in considerable quantities in a host of other trades and industries including oil, chemicals, metals, cotton mercerising and bottle washing. Every day many hundreds of tons are distributed, for use both at home and abroad, the most recent development being the regular shipment of cargoes of caustic liquor in modern tankers carrying between 9,000 and 10,000 tons.

It is obvious that adequate precautions must be taken with this, just as with any other materials whose use involves certain hazards, and familiarity should not be allowed to lead to carelessness or failure to use protective equipment. It is true, nevertheless, to say that only rarely is caustic soda responsible for serious accidents.

Knowledge regarding the safe handling of a chemical which is capable of inflicting serious burns is of primary importance. In a properly designed and equipped plant, personal injuries need not be incurred, and when accidents happen they are usually due to defects in equipment, omission to provide or use safety devices, or to failure of the human element through

forgetfulness or carelessness.

To ensure safety involves, therefore, all the following factors:

- (1) Knowledge of the hazards involved.
- (2) Correct design of plant.
- (3) Provision of safety equipment and its regular inspection and maintenance.
- (4) Training and subsequent supervision of personnel.

Commercial grades of caustic soda

Caustic soda is available in a number of forms suited to its various applications. These are:

(1) *Solid caustic soda.* This is commercially anhydrous caustic soda which has been poured in the molten state into non-returnable mild-steel drums in which it has solidified. In unpacking the solid ingot of caustic soda, the drum is destroyed.

(2) *Flake, petal and powder caustic soda.* These too are anhydrous grades. Flake caustic soda consists of irregular-shaped flakes about 0.02 in. thick and up to 0.5 sq.in. in size. The petal and powder grades are both made by breaking up the flake grade to varying extents. These three forms of the product may be grouped together as regards safety in handling.

(3) *Caustic soda pellets and cast pieces.* These are forms of anhydrous caustic soda which are convenient for handling and weighing out in small or medium quantities.

(4) *Caustic soda liquor 100° Tw.* This is a solution containing 46.5 to 47% caustic soda, which is usually delivered to the user in road or rail tankers and is also exported in sea-going tankers. It can be supplied to small users in drums.

(5) *Caustic soda liquor 73%.* This strong solution of caustic soda is delivered to the user in special, lagged, road tankers. It has a freezing point of about 65°C., so that the user's installation must be adapted for its reception and storage at elevated temperature to avoid solidification.

In recent years there has been a rapidly increasing tendency to use caustic liquor in place of the solid grades. Liquor offers a number of attractions to the user of medium or large quantities—such as delivery and storage in bulk, ease of distribution in the works, elimination of dissolving plant and appreciable economic advantage.

▲ Fig. 1. Drums of solid caustic soda being loaded into a river barge for subsequent trans-shipment for export.



Properties relevant to safety

It is not the purpose of this article to give a complete description of the properties and uses of caustic soda, and only those properties which have some bearing on safe handling will be described.

Attack on the skin. Caustic soda in contact with any part of the body will rapidly cause burns which will take a long time to heal unless they are attended to promptly. Eyes are particularly susceptible to damage, and immediate first-aid treatment is essential to save the sight.

Attack on clothing and fabrics in general. Articles of clothing, particularly those made of wool, are attacked by caustic solutions. Cotton gives greater protection than wool. For cold solutions, rubber and PVC offer good resistance.

When dealing with molten caustic soda, asbestos gloves should be worn, provided metallic sodium is not also being handled.

Action on metals. For the majority of commercial processes mild steel is a satisfactory material for constructing drums, tank wagons, storage tanks etc. for containing and transporting caustic liquor, and also for making vessels to contain molten caustic soda at temperatures up to 550°C. and possibly higher than this. In the U.S. it is sometimes necessary to build rail tankers of nickel-clad steel for transporting caustic liquor when freedom from iron is critical. In Britain, how-

ever, owing to the shorter distances involved, the additional expense of special materials is unnecessary, as there is no measurable iron pick-up during transit.

Grey cast iron is resistant to attack by caustic soda solutions and may be used when its mechanical properties are suited to the conditions of service.

Nickel and copper are satisfactory as regards their resistance to corrosion, but the ferrous metals are usually preferred on account of their lower cost. Brass is unsuitable, as certain grades suffer dezincification in contact with caustic solutions.

There are three common metals—aluminium, zinc and tin—which react readily with caustic soda solutions and some other alkaline chemicals, evolving hydrogen so that there is a risk of explosion and fire.

Caustic cracking and its prevention. One precaution is essential in order to prevent the occurrence of caustic cracking, a form of failure which is found in steel vessels, pipelines and other structures which have been put into a condition of stress as a result of welding, cold working etc. Steel in this condition, if subjected to the action of caustic soda solution of 30 to 70% concentration at temperatures exceeding about 50°C., will almost certainly develop intercrystalline cracks, leading to the leakage of the contents and possible injury to personnel.

This type of failure is quite definitely prevented by stress-relieving the parts involved before they go into service in contact with caustic liquor under the conditions defined above. The stress-relieving treatment consists in heating the parts uniformly to a temperature of 650°C., which should be maintained for a short time commensurate with their section thickness, and be followed by natural cooling in still air.

Grey cast iron is not subject to caustic cracking, and need not be stress relieved.

Hygroscopicity. The anhydrous forms of caustic soda have a powerful affinity for water. As soon as containers are opened, or a freshly broken surface of the material is exposed to the atmosphere, the caustic soda becomes wet, this indicating the presence of a strong caustic solution which is dangerous if it comes into contact with the skin or clothing, and particularly if it gets in the eyes.

Heat of solution. When caustic soda is dissolved in water, and when strong caustic solution is diluted with water, a considerable quantity of heat is evolved, and under some conditions this may cause boiling and the spurring of solutions out of their containers.

Slipperiness. Solutions of caustic soda have a characteristic soapy feel and, if the solution is spilled on to the floor, people walking on it may slip and fall so that their body and clothing may receive injury from caustic burns.

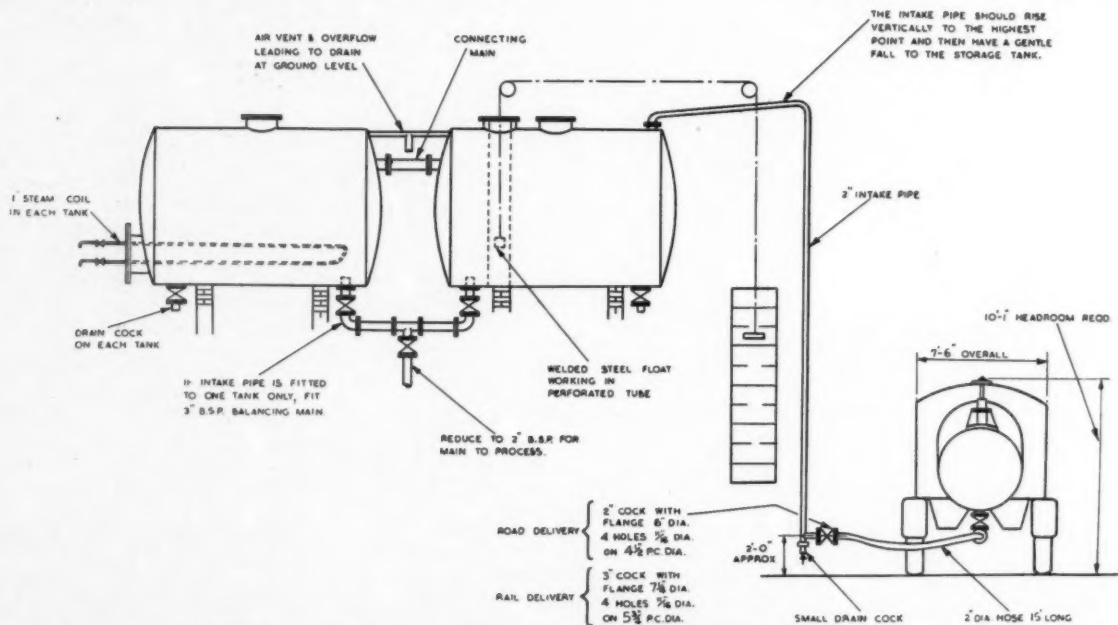


Fig. 2. Typical layout of a caustic soda liquor bulk-storage installation.

Bulk storage installations for 100°Tw. caustic liquor

Fig. 2 shows diagrammatically a typical bulk-storage installation, and is self-explanatory. The following points are of particular note in relation to safety.

(1) The intake connection should be clearly marked by means of a permanent metal label bearing the words 'Caustic Liquor—Intake.' This should prevent the accidental discharge of the wrong liquid into the tanks. The intake connection should be no more than 2 ft. 6 in. from ground level. It is particularly dangerous to make and break connections at eye level.

(2) There must be an indicator visible or audible to personnel engaged in discharging tankers and showing the level of liquor in the storage tanks. Reliance on dip-stick measurements is not a satisfactory substitute.

(3) If the installation consists of more than one storage tank, the tops of the tanks must be at the same level, and they should be interconnected near the top by mains which are permanently open.

(4) An air vent and overflow pipe must be fitted and must lead to a drain at ground level.

(5) Outdoor storage tanks should be provided with steam coils to prevent freezing of the liquor in cold weather. Steam should only be used to maintain a temperature of 20 to 30°C., and the steam coils themselves should be stress relieved, together with the cover to which they are welded for attachment to the branch pipe at the end of the tank. Pipelines for 100°Tw. caustic liquor, which are out of doors or in unheated buildings, should be made up in lengths which can be stress-relieved after fitting the flame joints. The actual joints should



Fig. 4. Removal of gloves without getting caustic soda on the hands.

be made with flanges and compressed, graphited, asbestos washers. The line should be steam traced by wiring a steam pipe to it and lagging the two as one (Fig. 3).

(6) Pipelines should be so arranged that they can be completely drained when not in use.

Personal protection

Personnel dealing in any way with caustic soda must wear goggles of approved type, and rubber or PVC gloves. Suitable goggles, while being sufficiently well ventilated for comfortable wear without misting, must protect the eyes from splashes not only from the front, but from above, below and the sides.

Gloves should be worn with the gauntlets inside the sleeves of the coat or overalls, so that liquor cannot run inside the gloves. Also there is a simple but important technique for removing gloves which may have become contaminated with caustic soda. This is shown in the accompanying illustrations (Fig. 4), and avoids getting caustic on the hands or inside the gloves. It should be practised habitually by those who are dealing with caustic soda.

Transport of 100°Tw. liquor

Caustic liquor of 100°Tw. (1.5 specific gravity) is very generally used in industry. This particular strength has been selected because it is the most concentrated solution which can be transported, even in winter in Great Britain, without any serious complications arising due to freezing. As the concentration further increases, the freezing point curve rises steeply.

The 100°Tw. liquor commences to freeze at about 8°C. (47°F.). It can be transported in unlagged road tankers not provided with steam coils, the liquor being loaded while warm and normally reaching the customer's works the same day.

Rail tankers, on the other hand, may be en route for several days and in winter the contents may freeze before they reach their destination. They are therefore equipped with steam coils and, if freezing has commenced, these should be connected to a low-pressure steam supply (25 p.s.i. maximum) as soon as the tankers reach the customer's siding, this operation being conveniently carried on throughout the night so that discharging can be started first thing on the following morning. It is important to unfreeze the whole contents of the tanker before commencing to discharge. If this is not done there may be difficulty in getting rid of the last of the frozen material.

Road tankers

Road tankers, with a capacity of 12½ or 14 tons of liquor, are pressure vessels equipped for discharging their contents either by gravity, compressed air or by a pump located at the customer's storage installation. A compressor supplying air at a maximum of 30 p.s.i., controlled by a safety valve, is carried on the tanker and is capable of discharging the liquor to a maximum height of about 30 ft. Pumps suitable for delivery to greater heights are described later on. Equipment for the first-aid treatment of caustic burns is carried on road tankers, and the box holding it should be kept open during the discharging operation ready for instant use should the need arise.

The tanks, constructed of welded and stress-relieved mild steel, are subjected periodically to the statutory tests laid down for pressure vessels. The very high standards observed have virtually eliminated the failure of tanks.

The liquor outlet is a 2-in. pipe, controlled internally by a wing valve, and at the outlet end by a specially designed and lubricated valve con-

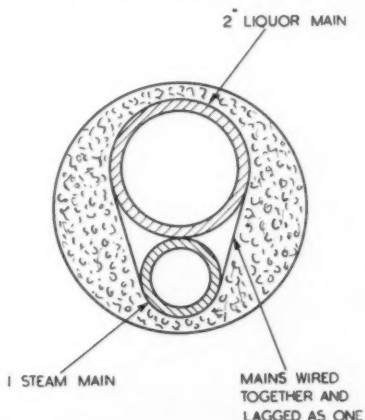


Fig. 3. Method of steam tracing and lagging caustic liquor mains.

structed entirely of ferrous metal. The wing valve prevents liquor from seeping into the outlet pipe during a journey, this being the vulnerable point where freezing would be most liable to occur in cold weather. The flanged outlet is covered by a steel plate to keep foreign matter away.

Sampling a tanker load

It is sometimes necessary to sample the contents of a road tanker before discharging. The correct way to do this is to open the manhole cover and take the sample in a small metal (preferably nickel) cup on the end of a rod, which is filled by dipping it into the liquor. The sample is immediately transferred to a glass container and closed by means of an *Alkathene* screw cap or rubber bung. Glass stoppers are not used, as they are liable to become firmly fixed.

After taking the sample, the manhole cover must be replaced and tightened if the load is to be discharged by pressure. For discharge by gravity or customer's pump, it should be replaced loosely so that it will admit air while acting as a splash guard.

Discharging road tankers of 100°Tw. liquor

The following sequence of operations should be carried out, bearing in mind that responsibility is shared between the tanker driver and the customer. The driver will have been specially trained to carry out his duties, but it is equally important for the operator at the receiving end to know exactly what he must do, and to do it with punctilious care. The safety of both is endangered by forgetfulness or carelessness on the part of either.

(1) The caustic soda user confirms (a) that there is sufficient space in the storage tank to accommodate the complete load, (b) that the intake valve is open and the draincock closed, (c) that the intake pipe is heated should circumstances require this and (d) that in the event of discharge by the user's pump, this is in working order.

(2) The driver, wearing goggles and gloves, first removes the outer cover from the outlet flange, and then connects the outlet flange of his vehicle to the customer's intake flange by means of a length of flexible hose which is part of the equipment carried on the vehicle. The joints are made using a rubber gasket and all four of the bolts provided for each pair of flanges. The use of only two bolts at a joint has led to mishaps involving personal injury, and is a practice which should not be tolerated.



Fig. 5. Taking caustic liquor from a drum by means of a safety siphon.

The next part of this description refers to discharge by the air compressor on the tanker, this being the usual method. It will need to be varied when discharge is by gravity or customer's pump.

(3) The driver, having checked that the manhole cover is fastened down, opens the tanker wing and outlet valves and starts the compressor. The load should be discharged in 20 to 40 min., depending on the height of the storage tank. When the last of the liquor passes over, the rush of air should practically empty the pipeline right to the storage tank. At this stage the driver stops the compressor, normalises the pressure in the tanker and closes the outlet valve and the wing valve.

If, during discharge, leaks are noticed at pipe joints or elsewhere, pressure in the tanker must be normalised before attempting to correct the trouble.

(4) The user closes the intake valve and drains the pipe into a bucket or directly to a drain through the drain cock, hosing down if necessary.

(5) The driver disconnects the flexible hose and washes away any liquor which drains from it. He then replaces the cover on the outlet flange, stows the flexible hose, and is ready for the return journey.

These operations are described in detail because they illustrate the standard of care which is necessary in the

handling of caustic liquor. The variations called for in discharge by gravity or customer's pump are fairly obvious.

Discharging rail tankers of 100°Tw. caustic liquor

The principles involved in dealing with rail tankers are similar to those for road vehicles, but the operations are wholly under the control of the customer. The points of difference are:

(1) In cold weather the contents of the tanker may have frozen, in which case it should be liquefied by steaming, as already described. Discharge should not be started until the complete load has been liquefied.

A frozen outlet pipe should be freed by playing a jet of steam on the outside. It is dangerous to open the valve and blow steam into the pipe.

(2) Discharge by compressed air makes use of the caustic soda user's air line, as rail vehicles are not fitted with compressors. Pressure must not exceed 25 p.s.i.

(3) The user provides the flexible hose, which in this case is 3 in. or 4 in. diam., depending on the size of tanker.

Delivery and storage of 73% caustic soda liquor

The essential differences between the handling and storage of 100°Tw. caustic liquor and 73% are (a) that the latter must be kept above 65°C. to prevent freezing (a suitable storage temperature is 75°C.), (b) that solid-drawn steel pipelines are used for conveying the liquor and are fitted for internal steaming before liquor is passed along them, (c) that provision is made for blowing steam internally along the delivery pipe back into the road tanker in the event of the tanker outlet branch and valve becoming frozen up, and (d) that the road tanker and the intake valve should never be coupled up by means of flexible armoured hose, but by solid-drawn steel pipe fitted with a sufficient number of steel ball joints to give the required degree of flexibility. The storage tank should be lagged and fitted with heaters.

Although there is some reason to think that caustic liquor containing 70% and upwards of caustic soda does not set up caustic cracking in steel, it is advisable that the individual lengths of pipeline used for conveying 73% liquor should be stress relieved before they go into service.

There may be circumstances in which it is necessary to store 73% liquor in nickel vessels, to prevent iron pick-up, but the rate of attack on



Fig. 6. Opening a drum of solid caustic soda. The vertical seam of the drum is first cut open (left) with the chisel-shaped end of a 5 to 6 ft. crowbar, and (right) the side is then stripped off by two men with crowbars.

mild steel is slow at temperatures up to about 130°C., and the sodium ferrite which is formed is only very slightly soluble in the caustic liquor. Provided it is allowed to settle, and liquor for use is drawn off 6 in. or so above the bottom of the storage tank, as in Fig. 2, it is only in processes which are particularly sensitive to the presence of iron that special structural materials are called for.

Pumps for use with caustic liquor

For distributing caustic liquor by pump, the centrifugal type of pump is the safest and the most satisfactory. The gland packing material should be graphited asbestos. As a precaution, to avoid liquor being splashed, the gland should be covered over and the pump should have underneath it a tray draining back into the stock tank. A valve should be provided on the delivery side of the pump, and liquor left in the delivery pipe may then be

used for priming the pump when necessary. Pumps located below the stock tanks will need no special priming arrangements.

Difficulties in maintaining glands may, of course, be avoided altogether by using a fully immersed vertical spindle pump.

All pumps except the immersed type should be provided with facilities for emptying and washing out with water.

Caustic liquor in drums

From the point of view of tonnage, the supply of caustic liquor in drums is relatively unimportant, but correct handling is just as important as in dealing with bulk.

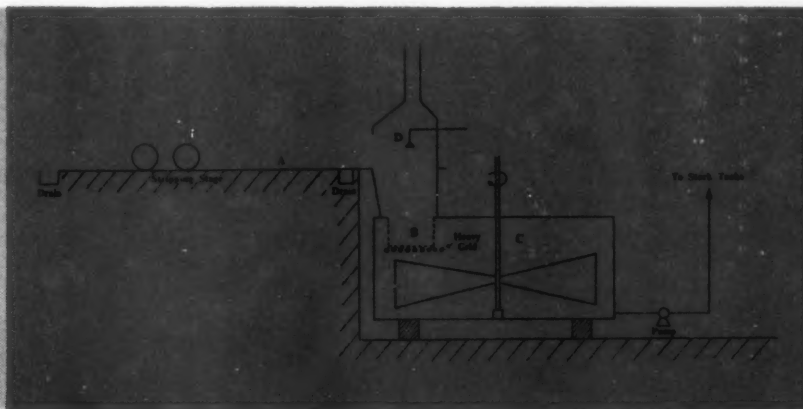
Caustic drums have a bung in the side and a vent plug in the end. Two methods of emptying are commonly used; both of them require—for safety's sake—that the drum shall be placed on a stillage.

The first method is by safety syphon,

such as the *Monopol*. The sequence of operations is, first, put on goggles and rubber gloves; then put the drum on to a stillage, with the bung at the highest point. Next, with head averted, loosen the bung by partly unscrewing it, and allow the pressure to equalise. Remove the bung, and insert the safety syphon, which is filled by two movements, after which the liquor may be drawn off as required through a tap (Fig. 5).

If a safety syphon is not available, up-end the drum with the vent plug uppermost and, wearing goggles and rubber gloves and with head averted, loosen the vent plug by partly unscrewing it and allow the pressure to equalise. Remove the vent plug and screw in its place a valve. Check that the valve is closed, lower the drum on to its side and lift it on to a stillage so that the bung is uppermost and the valve at the lowest point. Screw a spout into the valve, remove the bung

Fig. 7. Arrangement for dissolving ingots of solid caustic soda.



to admit air, and liquor can then be drawn off by opening the valve. When the drum is empty, replace the bung and up-end the drum before removing the valve and inserting the vent plug.

Under no circumstances should liquor be poured from the bung hole or vent plug by rolling the drum. This is not only highly dangerous, but it may cause contamination of the liquor by paint washed off the drum walls. Pouring spouts are obtainable to fit the bung hole, and the drum itself should be on a special stillage which allows it to be rotated.

Handling solid caustic soda

Drums of solid caustic soda are opened by splitting along the side weld with a crowbar and stripping off the drum as shown in the illustration (Fig. 6). This is a very quick and simple procedure once the technique has been acquired and should take less than a minute. The obvious danger to be guarded against is the risk of flying splinters of caustic soda. Operators should therefore wear goggles and cotton gloves, and the stripping stage should be on a steel grating 6 in. or so above a sunken and drained floor, so that it can easily be hosed down.

Dissolving solid caustic soda

Fig. 7 shows a simple and safe set-up for dissolving large quantities of solid caustic soda. After stripping, the ingots of caustic soda are rolled by means of crowbars along the stripping stage *A*, under a guard rail and into a hopper *B* set above a vessel *C*. The bottom of the hopper consists of a strong steel grid. Above it is a nozzle *D*, from which water is sprayed on to the ingots in the hopper. The solution collects in *C*, which may be fitted with a stirrer, and from *C* the solution is pumped to the point of use.

Single drums of solid caustic soda may be dissolved by suspending them, on a cradle, just beneath the surface of the water in a dissolving tank. The drum may be stripped before this is done or, if the presence of a little paint in the solution is not objectionable, it is sufficient to perforate the drum in several places with a pickaxe.

Handling flake caustic soda

Flake caustic soda is usually supplied in returnable drums with fully opening lids, i.e. the lid forms the complete top of the drum. It is therefore possible to remove the caustic by means of a scoop without the risk of any getting inside a glove or on

the clothes. In the event of only part of the contents being used, the lid can be replaced and fastened down to protect the remaining contents of the drum from atmospheric moisture and carbon dioxide.

It is perhaps worth mentioning that the attractive appearance of flake caustic soda is for some people almost irresistible, and they feel compelled to pick up a handful and allow it to trickle back into the drum. This can, of course, lead to painful burns if the material gets under the nails. It should be a strict rule never to touch caustic soda with bare hands. Also, there is a small amount of fines in the 'flake' grade, and still more in 'petal' and 'powder,' so it is important to wear goggles to guard against airborne particles.

Dissolving flake caustic soda

Flake caustic soda dissolves very readily if it is put into a wire basket suspended just beneath the surface of the water in the dissolving tank. The water used should be cold, or nearly so, at the start of the operation.

First-aid treatment of caustic burns

When caustic soda gets on to the skin or clothing, a 5% solution of ammonium chloride should be applied without delay. Whenever caustic soda is stored or used, this antidote should be kept within easy reach and should be stored in aspirators holding about 5 gal., so that it can be applied simply by unhooking a rubber tube and allowing the liquid to flow on to the affected part.

If there has been such delay in the application of the solution that some destruction of the epidermis has taken place and there is actually a burn, the part affected should be drenched with ammonium chloride for 10 to 15 min. and then washed continuously with running water or saline/boric lotion* for a period of an hour. The burn

should then be dressed with a four-fold pad of lint soaked in Bonney's blue paint.† This dressing should be left undisturbed until it drops off without aid, when the burn will be found to have healed completely. No infection can possibly take place if the tissues have been thoroughly dyed by the blue paint.

Caustic soda in the eyes

If caustic soda gains access to the eye, the eye should be washed immediately with the complete contents of one eyewash bottle (8 to 16 oz.) of 5% ammonium chloride solution. Such bottles should be placed conspicuously in boxes on the plant so as to be immediately available when needed. This treatment should be carried out on the spot by one of the man's mates. The man should then be removed to the works surgery or other convenient place and the eye irrigated with running saline/boric lotion or, failing this, clear water preferably at body temperature, continuously for one hour, taking special care that the lotion reaches the corners and the lower sulcus. This prolonged irrigation is of extreme importance and must be done at once. If such a case is sent to hospital without this preliminary irrigation, irreparable damage will have been done. This can only be prevented at the time of the accident by the procedure described.

An alternative first-aid treatment for eye burns which is less painful than the application of 5% ammonium chloride solution is as follows.

The eye should be immediately washed out with the complete contents of one eye-wash bottle (8 to 16 oz.) of a buffered phosphate solution made up to the following formula:

Potassium dihydrogen phosphate (KH_2PO_4)	...	27.22 g.
Dibasic sodium phosphate ($\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$)	...	71.63 g.
Distilled water to	...	1 l.
Brilliant green	...	0.01 g.

This treatment must be followed by the prolonged irrigation treatment with saline/boric lotion as described above, under medical supervision.

In order to prevent eye burns, the most satisfactory precaution is to insist on the use of efficient goggles.

Portable first-aid sets should be available when caustic soda is used in isolated positions away from the plant.

The proper maintenance of all protective and first-aid equipment is essential, and a responsible individual should undertake the regular inspection of goggles, gloves etc., which should be replaced when damaged.

*Saline/boric lotion is made up in double strength as follows: sodium chloride, 45 g.; boric acid, 50 g.; distilled water to 2½ l. This double-strength lotion should be stored in Winchester bottles. At the time of using, it should be diluted with an equal volume of warm water in a wash bottle to make a lotion at about body temperature. The temperature is correct when a little of the lotion poured on the back of the hand feels just warm and no more.

†Bonney's blue paint is prepared by dissolving crystal violet and brilliant green, 0.5% w/v of each, in equal parts of alcohol and water. (See Martindale, 'The Extra-Pharmacopoeia,' 1952, 23rd edition, p. 1,242, 'Pigmentum Tincturium'.)

Avoidance of Stress Corrosion in Austenitic Steel Equipment

By C. Edeleanu, M.A., Ph.D.

(Tube Investment Research Laboratories)

In the following article the author discusses the present state of knowledge of this subject. He then deals with stress corrosion in plant using chloride or caustic solutions and plant using water or steam.

Finally, the importance of stress corrosion is considered.

STRESS-CORROSION failures occur most frequently in equipment which, at first sight, is not subjected to particularly vicious corrosive conditions. Furthermore, the cracking is frequently the only obvious damage the material has undergone and there is little or no other sign of 'corrosion.'

It is, therefore, not unnatural that it is sometimes rather difficult for those who have not previously met this type of failure to accept the fact that corrosion has anything to do with the failure. The first reaction is that the material is 'faulty.' Up to a point this is correct, since the material has not fulfilled its purpose, but usually it is not faulty in the sense of having had some local weakness such as a large inclusion or internal crack due to the method used in its manufacture.

If the failure is intercrystalline, it may be that an insufficiently stabilised steel has been used or that the steel has picked up carbon during some stage of its manufacture or during fabrication. In such cases the difficulty can be overcome by calling for stabilised steels or low-carbon grades and taking the necessary care during fabrication.

The position is most difficult when the cracking is of the transgranular type, since all the normal austenitic compositions are susceptible to this type of failure, and since the variations either from cast to cast, or from quality to quality, are so small that except in special cases they may not be worth considering. It seems, therefore, that when transgranular stress corrosion is met in austenitic stainless steels the material has been exposed to a set of physical and chemical conditions which, at least for the present, we must accept are too severe for these steels and that it is then necessary either to use a different material or to modify the conditions,

in order to give the steel a chance to survive.

Present state of knowledge

Laboratory experiments on transgranular stress corrosion have almost always been carried out with concentrated chloride solutions and, from time to time, it has been asked what relevance these experiments have, since the most frequent service failures occur in hot water and steam service and under conditions where concentrated chlorides are not an obvious possibility. In point of fact, in many of these cases a closer examination shows that, even starting with very pure water or steam, the steel can become contaminated either with a concentrated chloride or caustic solution, both of which are equally effective in causing cracking. There is, therefore, every reason for accepting the data obtained in various chloride solutions as relevant.

It has been shown that the failure is much more rapid on concentrated chloride solutions than in dilute ones^{1,2} and extrapolation of these results to the concentrations of chlorides met, say, in tap waters, shows that rapid cracking in such solutions is very unlikely. It has also been shown³ that there is a marked temperature effect and that rapid failures can only occur at high temperatures.

Using concentrated solutions such as 42% $MgCl_2$, it has been found that most of the 18/8 steels, whether tested as U-bends or as tensile specimens loaded to a known extent, give a very similar life, and there is no appreciable difference between stabilised material and the plain 18/8 steels. Molybdenum additions do not affect matters to a significant extent. Certain casts of the titanium stabilised steel do sometimes give long lives and it

seems that there is some correlation between the delta ferrite content and the susceptibility of this steel to cracking.⁴ A similar effect was previously noticed with the plain Cr-Ni steels² and in certain casts of Cr-Ni-Mo steels, but it is not at present considered a practical proposition to improve the resistance of the steel in this manner, partly because it is not entirely clear why a high delta content does not always lead to improvement, and partly because stress corrosion is only one of the considerations, and a rather unimportant one, in deciding what is a desirable practical composition.

An improvement² can also be achieved by increasing the nickel content of the steels, and there are both niobium and titanium stabilised steels available commercially with about 11 to 13% nickel. The improvement is not, however, considered really sufficiently great to justify the use of these higher-nickel steels solely on stress-corrosion considerations except in very special circumstances. Higher-nickel steels are even less susceptible, but, as the nickel is increased, various manufacturing and fabrication difficulties are met, and it is not clear whether an alloy somewhere in between the nickel-base type and the steels could be justified because of stress corrosion alone.

Effect of stress

One of the factors which at first might appear to be of prime importance is stress, both internal and applied. If there is no stress, the material does not deteriorate in use. In this respect transgranular cracking differs from the intercrystalline type of stress corrosion since in the latter case, even in the absence of stress, the material more often than not suffers

intercrystalline corrosion to some extent. Up to a point the larger the applied stress the more rapid will be the transgranular type of failure, but, somewhat surprisingly, rolling or similar manufacturing processes sometimes lead to an increased resistance. The effect of cold and warm work appears to be very complicated and no hard and fast rules can be given. The experimental evidence available can be best explained by assuming that each cast is more or less different in this respect and that for each there is a certain amount of strain which leads to most rapid failures. The temperature at which the strain is introduced is important and, on the whole, it is felt that warm work is preferable to cold work, assuming, of course, that it does not lead to other complications such as sigma formation.

From a practical point of view, if the plant under consideration is large or complicated it will always have sufficient stress present to make cracking a possibility. In such cases there is little to justify annealing treatments which might even do more harm than good and which are both troublesome and expensive. It is probably best to keep design stresses down as far as practicable if for no other reason than to prevent complete failure at the very first crack, but stress corrosion cannot be avoided in this way except in very simple cases. It is much more important to consider at drawing-board stage the chemical conditions to which the steel will be exposed. This matter will be discussed later.

The only remaining factor to consider is heat treatment. Unlike intercrystalline stress corrosion, the transgranular stress corrosion is virtually not affected by heat treatment. Unstabilised steels can be treated so that they are highly susceptible to intercrystalline corrosion, but there is no indication that this influences transgranular stress corrosion. The precipitation of carbides in the stabilised steels, or even of sigma phase, has little effect and, although the softening temperature may influence the micro appearance of the cracking to some extent⁴ there is no obvious practical lesson to learn.

To summarise, it seems, therefore, that for stress corrosion it is necessary to have a reasonably concentrated chloride or caustic solution and that the temperature must be high. There is little or nothing that can be done by heat treatment or by trying to avoid stresses, except in very easy cases such as simple pressings. All the austenitic steels are susceptible, but there is a

difference of a factor of 10, or at best 100, between the 'best' and 'worst' commercial steels. This would naturally be important if it were to increase service life from, say, one year to ten, but is insignificant if the increase is from a few hours to a few weeks. The only real solution at present is to avoid the exposure of the austenitic steels to those chemical conditions which it seems, they cannot withstand.

Plant using chloride or caustic solutions

When it is necessary to handle chlorides or caustic it is obviously necessary for the steel to be in contact with these substances. Such plant includes, for example, refrigerating

plant using calcium chloride brine and various evaporators.

The refrigerating plant would probably be safe for very long periods because of the low temperatures, but if, as is often the case, steam is introduced periodically to part of the system for sterilisation, there is a short period each day during which rapid cracking can occur. As is widely known, there is a great deal of stainless-steel plant made for such application and, although it has generally proved successful in practice, failures have occurred¹ from time to time.

Since the chloride cannot be easily avoided in this case, serious consideration must be given to methods of sterilisation not involving too much heat. When this is also impossible the prob-

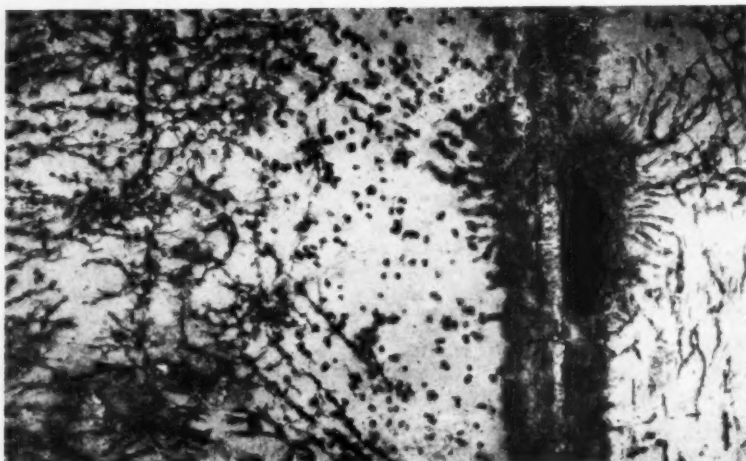


Fig. 1. Outside appearance of a hot-water storage tank cracked from the outside because of the concentration of impurities in the lagging material.

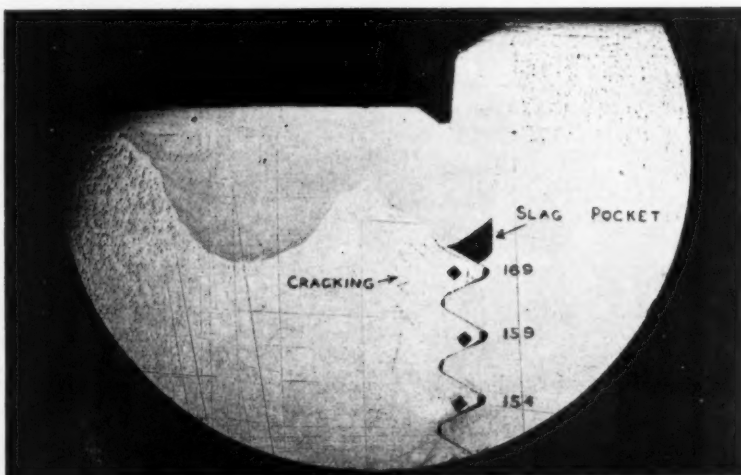
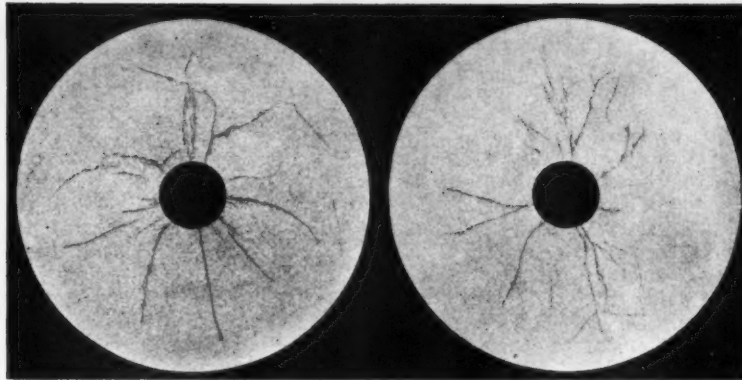
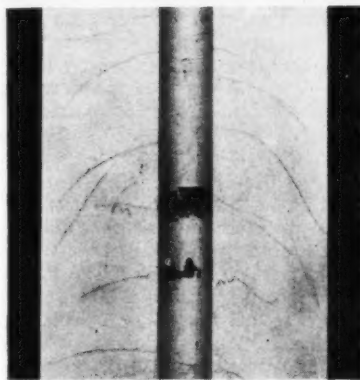


Fig. 2. Cracking in a laboratory apparatus using distilled water at a place where impurities are thought to have concentrated because of heavy boiling in a restricted space. (D.P.H. with 30-kg. load.)



Figs. 3 and 4. Sections through a laboratory high-pressure apparatus which cracked very rapidly under conditions likely to have left a thin film of caustic in the bore.

lem becomes very difficult. It seems advisable to use the lowest brine concentration consistent with the refrigerating temperature, and also to keep the sterilisation cycle as short as possible. It might sometimes be a practical proposition to drain the calcium chloride before introducing the steam, but, if this is done, care must be taken to avoid leaving small pockets of chloride in various gaps which may be present, if the matter has not been considered at the design stage. The case is a difficult one and it is much to the credit of the designers of such plant that it is as successful in practice as it appears to be.¹ Up to a point, the chloride solutions can be made somewhat less dangerous by keeping the pH high and keeping air out of the system, but neither of these methods can lead to a complete solution of the problem. It might be possible to use cathodic protection in some special circumstances, either in the form of an applied current or using suitable sacrificial anodes. The author knows of no case outside the laboratory where the method has been tried, but sees no obvious reason, except the inconvenience of the method, why it should not be successful in practice.

The other case mentioned above, the evaporator, is equally difficult. If the design is really simple it may be possible to avoid stresses in evaporating dishes, but this is not very easy if the plant is partly made out of mild steel, because of the difference in coefficient of expansion. If stress cannot be avoided and if the solution being concentrated is really a very difficult one and cannot be made less dangerous by, for instance, pH control, it may be best to accept the fact and carry out the final concentrating in containers made out of a more suitable material. The U-bend type of test²

is very simple and one which can be carried out even if no laboratory facilities are available, so that it should be possible in many cases to obtain a fair idea of the possible dangers in any given case. If U-bend tests are carried out, it is important to prevent electric contact between the specimen and containers.

The cases just considered are very difficult, but dilute chlorides such as sea water often have to be handled. This is done quite successfully, provided care is taken to avoid unduly high concentrations building up in the plant. This can occur surprisingly easily, especially on heat-transfer surfaces, as will be explained in the next section.

Plant using water or steam

Plant using reasonably pure water or steam can also suffer stress corrosion, which at first appears surprising. In most cases, however, a closer examination would show that the conditions were not as believed. For example, a hot storage tank, or pipe carrying steam or water, would normally be lagged in some manner or other to prevent heat losses, but this lagging may have been exposed to rain or to other impure water (e.g. leaks from the actual tank or pipe). This impure water would then partly dry, leaving the solids behind, so that eventually the lagging would become contaminated with a highly concentrated solution, and then conditions on the outside could be right for cracking. An example of a hot-water storage tank that failed in this way is shown in Fig. 1, and it is typical of a fairly wide class of failures. Cracking of dye vats which sometimes were placed inside the older wooden ones which they replaced used to be reasonably frequent before it was appreciated that this was

not a very satisfactory practice. The outside of the vats was being exposed to unnecessarily high corrosive conditions just as was the lagged hot-water tank in Fig. 1.

When cracking occurs from the 'working' side of the plant, the position is slightly more difficult, since it may be necessary to interfere with the process to some extent. What has to be avoided at all costs is the production of highly concentrated chloride or caustic solutions at places where the temperatures are high.

Places where there is heavy heat transfer and where there is constant boiling, with the formation of more or less permanent steam pockets, are normally the danger spots. Fig. 2 shows a typical case of a failure which has occurred in a piece of laboratory apparatus used for stress-corrosion testing in high-pressure steam and water. The apparatus, which is described in greater detail elsewhere,³ was such that heat was supplied from the outside and that boiling in all probability occurred in the small gap between the threads, leading to a local concentration of either chloride or caustic. This sort of gap, when present at places of heavy heat flux, has been found time and time again to lead to cracking, even starting with water pure by laboratory standards. Sometimes the failures have been rapid. The particular apparatus shown in Fig. 2 did not even survive the three to four heating cycles necessary for the initial test purposes, and had a life measured in hours. It is interesting to note that the weld metal was only put down in an effort to repair the damage which occurred on these threads. The design stresses were then insignificantly small and the hardness measurements show that there has been little cold work.

This sort of gap has to be avoided

at places of heavy heat throughput, and a typical type of plant in which it occurs is the tubular heat exchanger in which the tubes are expanded into the tube plate. No matter how well this is done, sufficient gaps are always left here and it is probably better to avoid this type of design at the hot end of heat exchangers in which there is a chance of chloride or caustic build up. Collins⁶ gives a number of other 'good' and 'bad' design examples with which the present author fully agrees.

Concentration effects can occur without such gaps and another obvious case is when a solution level is falling in a heated container. A typical example of this occurred at a point somewhat higher than the position shown in Fig. 2. In this case the solution was known to contain caustic and because of a slight leak the level fell during two heating cycles. The state of the tube after this treatment can be judged by Figs. 3 and 4. Since this particular tube had had 18,000 hr. service before these final experiments with caustic solutions, it was not known to what extent cracking had occurred during its previous service. The experiment was, therefore, repeated with a new tube and this failed in a very similar manner in a matter of 1 to 2 hr. It is interesting that the working stresses due to the pressure inside the tube were insignificant, and almost certainly the major stress was due to the difference in temperature between outside and bore. An obvious lesson from this case is that the use of heavy wall plant is no safeguard.

There are numerous other ways in which concentration effects can occur and, in many cases, it should be possible to minimise the danger by suitable design or by taking reasonable care in the mode of operation of plant. It is obvious from Figs. 3 and 4 that considerable damage can occur during one single heating-up cycle and, although this is a somewhat spectacular case, it is felt that in service a satisfactory life for plant depends greatly in avoiding even a few short periods of really severe conditions. Comparison of total length of service of two similar plants does not really give an indication of which plant has been constructed from the best material unless a guarantee can be given that there has been no difference in operation. The tube in Figs. 3 and 4 was made from an 18-12Nb steel and had, as stated before, operated successfully for 18,000 hr. Had it been made from an 18-8 steel

it probably would have failed, say, half an hour earlier and, alternatively, had it been made from an 18-16 or similar steel it might have survived an hour or two more of the treatment it received just before failure. Obviously the service life in a case like this depends on when a set of circumstances combine to make chemical conditions really severe and is not greatly affected by susceptibility to stress corrosion.

How important is stress corrosion?

This is a very difficult question to answer. There is a great quantity of steel performing satisfactorily under conditions which, from what has been said above, could be expected to lead to cracking. It may be that some of the material still in service is cracked, since the nature of the cracking is such that it very seldom leads to anything other than rather slow leaking even in pressure equipment (*cf.* Figs. 3 and 4). On the other hand, the majority of the equipment in service is probably quite free from cracking. It must be remembered that not every 'water' when evaporated to dryness need necessarily produce a dangerous concentrated solution. Probably, if relatively insoluble substances such as sulphates and carbonates come down first (as is generally the case with many waters), the conditions never become very severe. Aeration is also an important factor, especially with chlorides,^{5, 7} and in plant partly made from mild steel there may sometimes be a certain degree of cathodic protection.

From such laboratory work as has been done on the subject,^{5, 7} it would appear that high-purity water contaminated with traces of either chlorides or caustic are dangerous, and also relatively impure water, but containing a high proportion of chlorides (*e.g.* estuary waters). It may be that

normal town waters are not too bad in this respect and that steam and steam condensate varies greatly from boiler to boiler depending on water treatment conditions and the amount of carry over.

Summary and conclusions

Transgranular stress corrosion of austenitic stainless steel is a failure which occurs with all the normal austenitic stainless steels. The information so far available is that the failure is only rapid with concentrated chloride or caustic solutions and only at elevated temperatures. Under these conditions it is so rapid that even the least susceptible of all the available steels cannot give a reasonable service life, so that it is suggested that it is more important to ensure that the steel is not exposed to unduly severe conditions than to select the least susceptible steel available. It is impossible to avoid stress to a sufficient extent to avoid stress corrosion in any but the simplest plant. Laboratory tests have shown that heat treatment does not influence the cracking to an appreciable extent and with all but the simplest plant there is no point in annealing treatments.

Concentrations of chlorides and caustic should be kept as low as consistent with the process, and temperatures should not be allowed to rise unduly in plant using solutions of these substances. A few hours of careless operation may, if it leads to a rise in concentration or temperature, spoil plant which otherwise might have been satisfactory.

Plant using reasonably pure water and steam is thought to fail mainly because of the formation of highly concentrated caustic and chloride solutions as a result of evaporation. It is reasonably easy to foresee where and under what circumstances these concentration effects might take place and at present the only solution is to avoid these effects. Not all waters and steam are equally dangerous from this point of view, but practical experience on which are the most dangerous combinations is not available.

REFERENCES

- ¹G. H. Botham, *Chem. & Ind.*, Oct. 27, 1956, p. 1165.
- ²C. Edeleanu, *J. Iron & Steel Inst.*, 1953, 173, 140.
- ³J. G. Lines and T. P. Hoar, *Ibid.*, 1956, 184, 166.
- ⁴C. Edeleanu, 'Stress-Corrosion Cracking and Embrittlement,' John Wiley & Sons, New York, 1956.
- ⁵*Idem*, *J. Iron & Steel Inst.*, 1957, 185, 482.
- ⁶J. A. Collins, *Corrosion*, 1955, 11, 11.
- ⁷W. Lee Williams and J. F. Eckel, *J. Amer. Soc. Naval Eng.*, 1956, p. 93.

To Authors

The Editor welcomes practical articles and notes on chemical engineering and related subjects with a view to publication. A preliminary synopsis outlining the subject should be sent to The Editor, CHEMICAL & PROCESS ENGINEERING, Stratford House, 9 Eden Street, London, N.W.1.

Chemical Engineers for Tomorrow

INDUSTRY'S NEEDS AND METHODS OF TRAINING

The question of how Britain's industries can obtain more chemical engineers is a vital one at the moment; considerations as to how best they can be trained are inevitably involved. Is the best use being made of existing facilities? Is industry getting the type of chemical engineer it wants? Is the average university curriculum too wide or too narrow in its scope? Are the technical college courses making the progress they should? These were among the questions that engaged the attention of the Symposium on Chemical Engineering Education held at the University of Birmingham in April, organised by the Institution of Chemical Engineers. Speakers at this symposium included leading figures in chemical engineering, and the calibre of the contributions can be judged from the fact that the authors included, among others, the president of the Institution, six professors, distinguished representatives from industry and the head of a well-known public school.

FROM the discussions it was plain that there is still a wide divergence of opinion about what should go into university chemical engineering courses and whether the emphasis should be on inculcating the student with scientific method or on teaching the application of knowledge to actual industrial applications. One interesting trend revealed by the symposium is the growing recognition of the value of chemical engineering science (as distinct from chemical engineering) as an essential part of the course. The value of mathematics was emphasised by more than one speaker, and Prof. Coulson stressed the need to have a greater number of children from the schools passing in mathematics; this, he said, was the whole key to chemical engineering science.

Industry's point of view did not come out very strongly in the discussion about methods of training, and this was a pity, since one of the most interesting questions raised was the place of practical training, including operational experience. Mr. D. S. Vickery (Shell Haven) spoke of the problems of the raw recruit in industry and stressed the need for adequate operational experience at an early stage of his career. Some of the educational

leaders present, such as Dr. Rumford, were for the inclusion of plant operation experience in the course, while others felt that there was not so much need for practical problems to be included, as the chemical engineer would have plenty of time to gain experience with these after his entry into industry.

Undoubtedly the most challenging contribution to the discussion came from Prof. Newitt, whose summing-up of the symposium is briefly reported at the end of this article, and who advocated drastic changes wherever they were necessary. His views were criticised by Prof. Sellers, who maintained that present courses did, in fact, show that there was a recognition of new needs. Some points from the papers and Prof. Newitt's summing-up are briefly summarised below.

Industry's requirements

The requirements of the chemical industry were discussed by Dr. D. Clayton (I.C.I. Ltd., Billingham), who saw the present phase of development of chemical engineering education as one of simplification; once the purpose of this education has been established, a phase of exploration to discover new and better means to achieve this purpose can be profitably indulged in.

The chemical industry has no notable requirements for chemical engineers that differ seriously from those that must hold for the other process industries; in fact, it appears that the one underlying theme is good basic training in the fundamental chemical engineering phenomena, at both the university and the technical college. What is required in the way of development is the more uniform recognition of chemical engineering as having a definite territory of its own, the sorting out of the fundamentals that can be adequately treated and exercised within the normal length of course, the minimising of technological material to keep the course normal in length, the acceptance by industry that it must take the responsibility for technological training and the recognition that chemical engineers will often work alongside other professional employees and can rely on them to play their part.

The oil refining industry's requirements were summed up by Dr. F. Mayo (Esso Petroleum Co. Ltd.). The variable nature and pattern of the industry was a point to bear in mind; oil companies have to be flexible bodies and for their efficient operation they require flexible men.

The desired proportion of chemical engineers out of the total intake of scientists and technologists would probably vary somewhat from place to place, but the figures for Fawley were significant. If they had a free choice they would like to recruit about 52% chemical engineers out of the total technologist and scientist intake. The actual figure, however, was far below the ideal and the position was regarded as serious.

Chemical engineers are found in many Government departments in a variety of posts, but the majority of chemical engineers are found in the scientific officer, experimental officer or professional (engineer and chemist) classes in the Ministry of Supply, D.S.I.R. Establishments and the Atomic Energy Authority. Mr. A. S. White (Atomic Energy Research Establishment, Harwell) dealt with this subject and explained that the requirements were similar to those of industry, although proportionally there was less scope for the aspirant to plant management. In the research and development field a good academic background, preferably with postgraduate experience, is required of the scientific officer, but the academic qualification must be backed by the 'spark' of the research worker. There is also the need for good 'sub-professional' men, who are keen to qualify professionally, to assist in the research and development field at a rather lower academic level than the scientific officer. In the design engineer the essential requirement is a sound background of engineering science and practice with a progressive outlook.

Two representatives of the chemical plant industry, Mr. J. P. V. Woollam and Mr. J. D. McFarlane, both of Simon Carves, presented the facts about this industry's requirements from its chemical engineers, mainly in fields of personal qualities which can-

not be the subject of the university curriculum. The importance of cost consciousness was stressed and it was pointed out that, while it is not necessary for the average chemical engineer to be able to estimate the cost of a unit to a degree of accuracy necessary for a tender, the ability to work out rough prices for the purposes of budgeting figures and economic balances is unlikely to go unrewarded for long.

Ability to express ideas with clarity, and a reasonable amount of experience with drawings, were among other desirable qualities discussed, while it was recommended that a chemical engineer should always be alert and on the lookout for new ideas and processes which might come from reading journals, attending meetings and discussions with people in other walks of life and it was for the employer to see that these opportunities were exploited to the fullest possible extent.

Methods of training

Prof. F. H. Garner, O.B.E., discussed full-time undergraduate training and in the course of his paper he drew attention to the fact that the chief difference between different university courses is the point at which chemical engineering proper is introduced. There was much to be said for its introduction at as early a stage as possible, since it served as a means of showing that all the pure science and other engineering subjects included in the course could be considered as branches of chemical engineering.

Regarding the chemical engineering content of the course, or rather that part of the course studied in the chemical engineering department, this must be considered as flowing from the earlier courses. It would include thermodynamics and reaction kinetics, the unit operations treated not as a series of separate operations but considered as a whole with a common method of approach to the mechanism of mass transfer, and with application to specific processes.

As chemical engineering itself is expanding and changing continually, so undergraduate courses in chemical engineering must change continually to present in clearer form the basic principles.

The historical development of the diploma postgraduate system of training chemical engineers was traced by Prof. M. B. Donald (University College, London) and the problem of joint instruction of postgraduates and undergraduates was reviewed.

In the diploma course in chemical

engineering, the intake over many years had been about 95% chemists and 5% mechanical engineers. Also, with regard to the chemists, most of them had a distinct leaning towards physical chemistry. From these facts it could be concluded that the best basis for a chemical engineer was a physical chemist, not that chemical engineering is an extension of physical chemistry.

The paper of Dr. P. F. R. Venables (College of Technology, Birmingham) surveyed the provision of courses in chemical engineering in technical institutions and discussed their potential development, principally that of part-time day and sandwich courses. Of sandwich courses, it was pointed out that out of the total of 174, less than 10 were in chemical engineering.

It is possible to qualify as a chemical engineer by passing the examination for Associate Membership of the Institution of Chemical Engineers by private study, and this question was dealt with by Mr. G. U. Hopton, chairman of the board of examiners of the Institution. The three ways in which a student can train by private study are by correspondence course, by private lessons, and entirely on his own. Training by private study should not be attempted unless the student is engaged in work of a chemical engineering nature where he can profit from the advice of a qualified chemical engineer, and obtain the experience which is necessary in applying theory to practice.

New teaching trends

The essential feature of any chemical engineering training is *design*, consideration being given to either analysis or synthesis. While most people hold that there is no substitute for experience in this, the blind use of empirical procedures has serious dangers, and use of such procedures can only safely be made on the basis of as complete a physical analysis of the functioning of the process or process plant as is possible. This physical analysis cannot be done without adequate mathematics, which has a definite role to play but also definite limitations in its utility. The teaching of mathematics in any course of chemical engineering must be continuous and at all stages associated with its physical and chemical applications.

The foregoing points were made by Prof. E. S. Sellers (University College of Swansea) who expressed the opinion that the average chemical engineer's

knowledge of the application of mathematical techniques was very low indeed. After giving examples of the usefulness of mathematics, he sketched briefly a three-year course in which, as the course proceeds, the teaching of mathematics is less and less formal. As greater knowledge of technique is acquired, the approach is changed, so that at the end mathematics is not even a separate subject, but as necessary a part of the whole, as is the English language.

The place of thermodynamics was the subject of a paper by Prof. K. G. Denbigh (Department of Chemical Technology, Edinburgh University), who pointed out that the case for making a generous provision for thermodynamics in the chemical engineering syllabus turned partly on its utility and partly on its educational value. However, an excess of thermodynamics would be harmful, for it would predispose the student to think too much in terms of equilibria, rather than rates. The paper concluded with some remarks on the presentation of thermodynamics, including some criticism of the excessive use of perfect gases.

Apart from its educational value and its practical uses, a third reason might be put forward for including a fairly generous amount of thermodynamics. This concerned the analysis of chemical manufacturing processes; in the working out of thermodynamic problems the student could obtain much insight into the method of making the proper choice of independent variables and this experience would prove of value to him in tackling the multi-variable problems of an industrial process, even though the latter may be concerned more with rates than with equilibria.

Practical training and its value to the student were dwelt upon by Dr. F. Rumford (Royal College of Science and Technology, Glasgow). If any form of training is to be of use it must have a definite aim, and the training of the chemical engineer must be directed to some positive end. The finished product is one who, to adopt the oldest Institution definition, is experienced in the design, construction and operation of chemical plant. It merely remains to devise suitable training to these three ends which, he maintained, could seldom be pursued simultaneously. The actual operation of chemical plant, and an analytical study of plant variables, is vital to chemical engineers, and only to chemi-

cal engineers. It must be noted that a very large majority of all trained chemical engineers will ultimately be engaged in the operation of chemical plant rather than its final design and manufacture.

Prof. Rumford expressed the belief that any scheme of training for a chemical engineer was sadly incomplete if it did not include actual experience on large-scale industrial plant and, as a stepping-stone to this work, practical work in a pilot-plant laboratory, and he went on to enlarge on this theme, discussing also the methods of training adopted at Glasgow.

Prof. J. M. Coulson (Durham University) spoke on the changing nature of the unit operation concept. He first recalled early ideas on unit operation and then showed how ideas about education were changing. He demonstrated that during the past 15 years the outstanding change in the educational approach had been the co-ordination of these unit operations and their treatment as aspects of either mass transfer, momentum transfer or heat transfer.

Discussing the future, Prof. Coulson referred to the creation of chemical engineering science during the past 10 years and suggested that it would be wrong to let this result in the feeling that chemical engineering science was synonymous with chemical engineering. One of the dangers of excessive concentration on chemical engineering science was that the student fails to appreciate the sense of urgency.

Getting more chemical engineers

Mr. A. A. Part (Under-Secretary for Further Education, Ministry of Education) spoke of the brighter picture for technological education today and of the various programmes now under way to ensure a good supply of scientists and technologists for industry. Two crucial factors on which the success of these programmes would depend were, of course, the supply of teachers and students. Of chemical engineering he said that much still remains to be done if this career is to compete as effectively as it should with careers in pure science and other more familiar kinds of engineering.

The opportunities open to chemical engineers must be brought home fully to young people and their parents and to the schools. A strong and up-to-date pattern of courses must be developed and industry must give those courses its most determined support by send-

ing students to them, helping with staff and encouraging research. All this requires the closest liaison between industry, the universities, the technical colleges, the Institution of Chemical Engineers and the Ministry.

Some interesting reflections on science training in schools were put before the conference by Mr. R. Groves (Master of Dulwich College). The teaching of science is now firmly established in all schools, and the aim of teachers is to produce scientists who are cultured, well-educated men. Such men are needed in chemical engineering where the qualities of leadership and adaptability are so essential. The two main difficulties in the schools are lack of laboratory space and the shortage of good science teachers. The former is being greatly helped by the Industrial Scientific Fund, but the latter is the abiding problem which must be tackled; some suggestions about this problem were included in Mr. Groves' paper.

Mr. Groves felt that there was not a great deal wrong with science taught in the schools these days. The schools knew their shortcomings and were constantly discussing and trying to improve their methods.

The final paper of the symposium was given by Mr. J. A. Oriel (president, Institution of Chemical Engineers), who pointed to the great future of chemical engineering, which of all the professions was the most thriving and the most vigorously growing. The fact that at least five times as many chemical engineers were needed as were leaving the universities and technical colleges at present was evidence in itself of the growing importance of the profession. Mr. Oriel spoke of the vital part played by chemical engineers in industry and gave as one example the petrochemical industry, in which the development of continuous processes had been entirely the work of the chemical engineer. Mr. Oriel enumerated the various roles played by the chemical engineer in industry and referred to the importance of having a working knowledge of instrumentation. One possibility for the chemical engineer was that of industrial research, while others lay in plant construction and in the operation of the finished plant. He pointed out that in Britain at present chemical engineers were almost equally divided between research, development, construction and opera-

tion. In the United States, where the profession had developed for a much longer period, there was a very much larger percentage in management and administration (including operation) than in any other openings. Chemical engineers were in administration in greater proportion than chemists or other engineers.

Review of symposium

A summing up of the symposium was given by Prof. D. M. Newitt (Imperial College of Science and Technology) and a summary of his remarks will be included in the June issue of *CHEMICAL & PROCESS ENGINEERING*. Here we present only a few points from his address.

In regard to the 'requirement,' Prof. Newitt agreed with the industrial speakers that the emphasis should be placed upon character development rather than upon functional proficiency. Drs. Clayton and Mayo had been on less sure ground, he said, when they attempted to assess the value of academic research and of postgraduate studies as part of a university education. The two years of postgraduate work was a valuable experience and a similar period in industry was not, in Prof. Newitt's view, a substitute for this.

Prof. Newitt pointed out that the problem of training has both its strategic and tactical aspects; at the symposium the tactical aspect had been stressed, but very little of a constructive nature had been said about policy. The syllabuses of practically all university, technical college and institution courses in chemical engineering were a legacy from the past—from the days when the functions of a chemical engineer were not well understood and when the subject was still considered to be a synthesis of chemistry and mechanical engineering with various oddments thrown in; they were all very much overloaded with extraneous material which, in the light of recent experience, might well be omitted. From time to time slight modifications had been made to existing syllabuses; the problem was one which could not readily be solved by half measures and a drastic reorganisation of the whole course might be found necessary. Prof. Newitt then went on to discuss this point further and gave the skeleton framework of an 'ideal' course, in which chemical engineering science, appearing in the first two years, served to link the physical sciences with the technology of the third year, without the intervention of other technologies.

USEFUL PRODUCTS FROM ANIMAL BLOOD

By L. M. Hirschberg, D.Sc., Ph.D.

ONE is to some extent justified in wondering why appreciable quantities of animal blood are still allowed to run to waste instead of being converted into such useful products as fertiliser—for which the demand is said to be higher than the supply—cattle food, albumen and other products. The following considerations may supply an answer.

Modern production methods, for economical working, require a large throughput and a steady flow of raw material. These conditions prevail in large slaughterhouses and at a locality where large quantities of blood, as fresh as possible, can be collected in close vicinity to the plant. Blood is subject to quick decomposition and may coagulate during handling and transport over longer distances, when it becomes unsuitable for the manufacture of, for example, high-grade cattle food and plasma. Attempts have been and are still being made to clot the blood at outlying slaughterhouses and send it in barrels to a central drying plant for conversion into fertiliser, but the working up of the clots is unpleasant and has its difficulties. Modern drying plant, yielding high-quality products, is expensive and the manufacturer may consider it an unprofitable proposition to invest capital in plant carrying a high rate of amortisation. Furthermore, progressive research is apt to alter the existing standards for the more important products of conversion and, to comply with these, may necessitate provision of additional or new plant. If it were possible to convey fresh blood over distances cheaply, one could foresee a considerable increase of production of cattle food and fertiliser.

In the past, blood has been used for the manufacture of fibrin, haemoglobin, prussiate of potash, blood charcoal and butyric acid and its esters, but their production, excepting haemoglobin, has ceased. Today the prin-

This article on the utilisation of animal blood and the manufacture from it of fertiliser, cattle food and albumen contains practical suggestions concerning the plant and processes involved and also goes into the economics.

cipal outlet for blood is its use as fertiliser and cattle food, of which large quantities can be absorbed, and as plasma, either undried or dried to blood albumen. A limited quantity of fresh blood and of the corpuscles resulting from the separation of blood, described later, is used in sausage manufacture. The industrial applications of blood are based mainly on its high nutritive value, almost approaching that of hen albumen and ox meat; on its high nitrogen equivalent and on the binding power of the albuminoids contained in it. These properties account for its use in the food industry, as cattle food, as a fertiliser and as a binding agent in waterproof glue, in radiator sealing compounds and, more especially, in plywood (for which large quantities are sent to countries like Sweden and Finland).

Properties and composition of blood

Blood is a suspension of blood corpuscles in blood plasma. Its specific gravity is 1.05, that of the plasma is 1.03 and of the corpuscles 1.09, the difference making possible separation using high-speed centrifugal force.

An analysis shows the following average content: water, 80.82%; corpuscles, 11.69%; albumen, 6.01%; fibrin, 0.42%; fat, 0.18%; extract substances, 0.03%; ash, 0.82%. The nitrogen content of dried blood of 10% water varies very considerably from 10% and less to 15% and more and depends not only on the processing and drying methods but also

on the kind of food given to the animal, the method of feeding, the temper of the animal and on seasonal conditions.

The following vital points should be taken into consideration in the processing of blood.

Blood will begin to coagulate at a temperature of about 160°F., forming an insoluble coagulum which becomes more and more liable to denaturation and loses digestibility. Therefore the drying of blood at higher temperatures will entail loss of digestibility besides possibly loss of nitrogen, both having an important bearing on the quality of the cattle food and fertiliser produced.

Such coagulation can also set in when the blood, in being drawn from an animal, is permitted to come in contact with the edge of the wound or other parts of the animal or with the walls of the collecting vessel. This phenomenon is due to the fibrinogen of the blood being converted into the solid fibrin which will collect and retain the corpuscles, thus causing appreciable losses. This can be prevented by care and improved methods of drawing, for example by means of a vacuum. Once the blood is drawn, coagulation can be impeded by mechanical and chemical means which will be described later.

Blood, which decomposes fairly rapidly, should be worked up as soon as possible, but, if it is to be kept for some time, it should be stored in a cold room at a temperature of about 40°F. When choosing the metal for the plant it should be borne in mind that blood

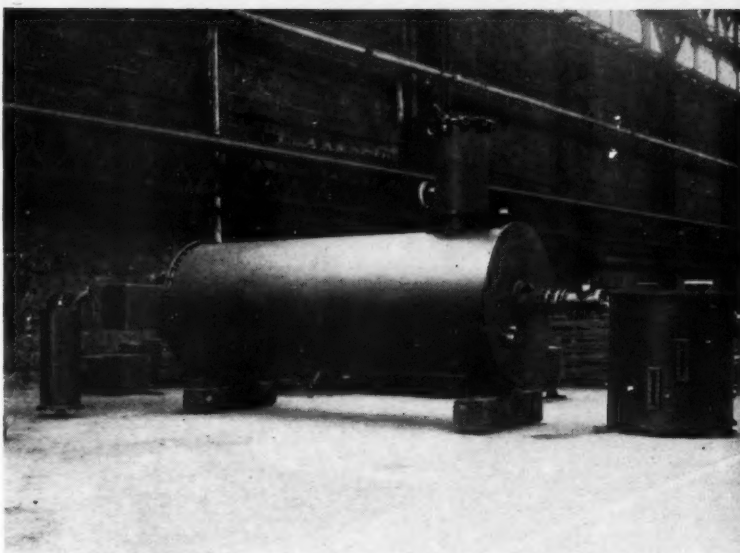
is very corrosive. It attacks galvanised metal, but stainless steel, aluminium and well-tinned sheets will withstand its action.

During the separation of the plasma from the corpuscles the haemoglobin is inclined to leave the latter and enter the plasma phase, thus imparting a more or less reddish colour to the latter, a phenomenon which is called 'haemolysis.' This should be avoided by cautious manipulation. A great difficulty, when drying blood, has been its tendency, due to the albuminous proteins, to adhere to the hot drying surface, but this has been overcome by the use of the spray drier and pneumatic drier. Whatever the drying process chosen, the fumes originating from more or less decomposed blood should be extracted.

General details of processes

It is essential to dry blood, not only to avoid losses caused by its decomposition but also to reduce its bulk and save package and transport costs. In the light of modern standards and requirements and of market conditions a prospective manufacturer has to decide whether to make a cattle food which is soluble and fully digestible or an insoluble fertiliser (though soluble types have come on the market recently) with blood plasma as a secondary product. His decision will depend on the considerations noted earlier. As the result of the unsettled conditions, there are still today a number of processes in use which do not take into account modern standards and employ out-of-date plant or plant, combining such with modern drying installations.

The blood is clotted in suitable tanks by the injection of live steam. After cooling, the clots are pressed to square blocks in an ordinary press—they have the consistency of cheese—and are then dried in a steam-



[Courtesy: Ateliers de Constructions Mécaniques de Vevey S.A.]

Apparatus for the treatment of 6,000 lb. of fresh blood in 8 hr.

jacketed drum. Coke-like briquettes are thus obtained which are crushed to a fine black powder in a hammer mill. A vacuum pump with a dry and wet end is usually provided to extract the fumes. In some cases, instead of pressing, the steam-coagulated clots are strained on a screen of a mesh similar to an ordinary flour sieve. The drying drum is horizontal and fitted with a horizontal agitator. Its capacity is as a rule $\frac{1}{2}$ ton and drying is completed in 7 to 8 hr. at 80 lb. steam pressure, the yield being about $2\frac{1}{2}$ cwt. from $\frac{1}{2}$ ton of strained clots.

Another method still in use is to clot the blood in a closed, steam-jacketed cylindrical vessel provided with an agitator, by passing steam into the jacket until coagulation is complete and, thereafter, applying a vacuum, reducing the water content

of the clots from 80 to 70%. After discharging the clots they are brought to dryness in a modern continuous pneumatic drier as described later.

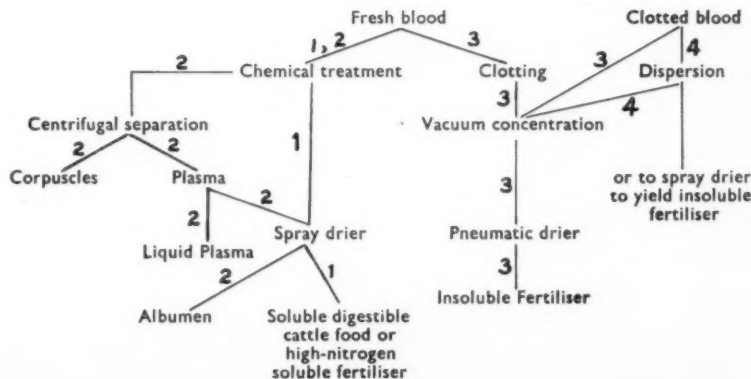
A third way of processing is to use clotted blood received from outside sources in barrels. The clots are broken up, by means of a steel bar, into pieces sufficiently small to be fed into a colloid mill where they are dispersed and strained into a tank through a fine brass sieve. The dispersion is continuously charged into a spray drier and yields an insoluble fertiliser.

By means of the above methods a dried blood is obtained, the water and nitrogen contents of which may vary—the former, for example, from 7 to 12% and the latter from 7 to 15%. A relatively small number of producers use direct spray drying of blood, as described below, and are thus able to manufacture a dried blood which is soluble, has a low water content and a high nitrogen coefficient.

Four methods of obtaining products from cattle blood

The diagram in the accompanying panel represents an attempt to devise a system by which, without running the risk of encountering mechanical difficulties from the use of untried plant, the following products can be manufactured.

(1) Dried blood of about 8% water content and even less, 98 to 99% soluble, with substantially the original nitrogen balance, subject to the precautions having been taken regarding drawing of blood etc. which have been



mentioned earlier. This product represents a high-class cattle food and, of course, can also serve as soluble fertiliser if such is required at any time in larger quantities.

(2) Blood plasma in liquid form, containing 8 to 10% albumen, or dried plasma of 99.5% solubility and a water content of 7 to 8% and blood corpuscles suitable for fertiliser production by methods (3) or (4).

(3) Dried blood, insoluble, of about 8% water and high nitrogen content for use as a fertiliser.

(4) Same as (3).

This system has the advantage of flexibility. By using a spray drier all the above types can be produced as a high-quality product from fresh blood. The employment of a pneumatic drier will lead to all the four products, except plasma in its dried state, in insoluble form and, if desired, clotted blood can serve as raw material.

In the following the process and plant necessary for using this system are described.

Method I

To produce cattle food by this method, fresh blood from healthy animals is required. The first step is to prevent coagulation of the blood. This was usually carried out by beating it immediately after it was drawn but, as this method was found to result in losses of up to 20% of blood and of highly nutritive substances such as fibrin which collected on the beater, the use of chemicals which keep the fibrinogen in solution was reverted to. Such chemicals are citrate and metahexaphosphate of sodium and a proprietary product, *Fibrisol*. A hot 20% solution of the latter, for example, is prepared, of which, for 1 litre of cattle blood, 50 ml., and for 1 l. of pig's blood, 60 ml., are needed.

The calculated volume of solution, which must not contain any undissolved particles, is placed in a trough of 25-l. capacity, made of stainless steel or aluminium sheet, and the blood is allowed to run from the wound direct into the solution, observing the precautions mentioned earlier. Such blood may be kept for about 10 days without risk of coagulation, but should be stored at about 40°F. It is collected in tanks of a capacity corresponding to that of the spray drier in use and in quantities which will enable the latter to be worked continuously.

During its conveyance to the atomiser of the spray drier the blood passes a filter, preferably of the dual

type, in order to retain any mechanical impurities and small clots likely to clog the atomiser.

So that fuel may be saved, spray driers are as a rule supplied together with a vacuum concentration unit intended to bring, previous to drying, the solid contents of the medium under treatment to 40 to 50%. Such concentration is best not employed in the case of blood because of its viscosity and, since it will, on concentration *in vacuo*, deposit a considerable quantity of sludge, necessitating very frequent cleaning and stoppage of the plant. The correct way is to feed the blood direct to the spray drier, which should work at an inlet temperature of about 165°C. and an outlet temperature of about 80 to 82°C., but not lower, since below 80°C. the blood powder tends to be moist. Under those conditions there is no risk of charring or of the heat-sensitive proteins becoming insoluble.

Though the danger of escaping fumes is small, it is advisable to interpose a vacuum pump between the main chamber and the dust collecting plant, not only to exhaust any fumes but also to obtain a more uniform particle size of the powder and save

mixing of the heavier powder from the chamber with the lighter dust of the collecting plant.

It is not proposed to give a detailed description of the spray drier and its operation here, but most particulars are obtainable from the makers of such plant. Spray drying is admittedly expensive, especially if carried out on a small scale, and therefore it can be recommended only for fairly large-scale production. However, compared with pneumatic drying and other methods, it must be kept in mind that spray drying requires little labour and supervision and is a completely straightforward proposition, not needing any additional plant and operations. The spray drier being primarily designed for drying heat-sensitive materials, the temperature of the air serving as the heating medium is low compared with the high temperature employed in a pneumatic drier. The air can be heated by a steam or oil-fired heater. It is a hazardous undertaking to give even an approximate figure for the costs of spray drying generally, since they depend on such factors as throughput, rate of evaporation, temperature, nature of material etc. However, to

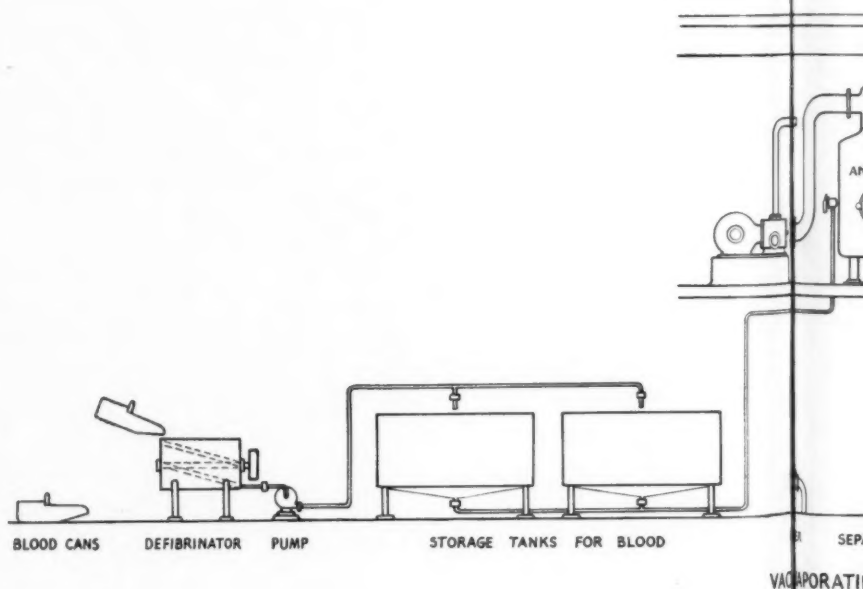


Diagram showing

give an indication, a unit capable of evaporating 400 lb./hr. of water would, under the above temperature conditions, consume about 1,200 lb. of steam of 120-lb. pressure to remove these 400 lb. from 500 lb. of 10% blood plasma being fed into the plant continuously.

Method 2

For the production of plasma and corpuscles the same chemical method as described under (1) is used to prevent coagulation of the blood. After filtration, the blood is subjected to high-speed centrifuging in one of the standard machines which are fed continuously and discharge continuously pale-yellow-coloured plasma at the rate of about 65% and blood corpuscles at the rate of about 35%. Care must be taken not to mix cattle's and pig's blood before separation and the separator bowl should be completely dry and filled with blood before starting the machine. Both plasma and corpuscles can be spray dried to yield a cream-coloured and dark-red powder respectively, these being easily water soluble and containing about 8% of moisture or less, as described under (1). For technical use the

liquid plasma can be preserved by the addition of one of the known phenol derivatives in proportions as recommended by the makers of the latter. The corpuscles can either be spray dried for use as cattle food or can be treated in conjunction with methods (3) or (4) to yield a fertiliser.

Method 3

This method is based on the use of the so-called pneumatic drier and permits working with not only fresh blood as such may be available on the spot but also with clotted blood which may be obtainable from outlying districts. The pneumatic drier, also called a flash drier, cannot be fed with sticky materials, as such materials cannot be blown, suspended in a current of hot air, through a duct as provided in this type of drier which, of course, is not meant for drying liquids.

To feed the drier it is therefore essential to clot the blood first to bring it into a feedable condition, but as the clots, containing 80% of water, are too sticky, their water content must be reduced to 70% to make them suitable for feeding. To achieve clotting and water reduction, fresh

blood or a roughly dispersed mixture of it with already clotted blood is drawn by means of a vacuum pump into a jacketed horizontal drum provided with a horizontal stirrer. Steam is then allowed to circulate in the jacket under stirring until heat coagulation is completed, when a vacuum is applied to the inside of the drum to reduce the moisture to 70%. This procedure does not take long, but, as the drier works continuously, it is advisable to provide two of these drums to ensure, through alternate working, continuity of the process.

The drum is discharged and the clots pass to the disintegrator of the drier where the conveyor at the bottom of the feed hopper feeds the plant at the required rate and the clots are at the same time broken up sufficiently to pass down a chute of 6 in. to 9 in. width directly into the disintegrator. The clots are dried and ground in one operation and, after remaining in the plant only for a few seconds, are discharged in powder form.

The principle on which the design of the drier is based is that of a hot-air current, carrying the material to be dried, being blown through a duct

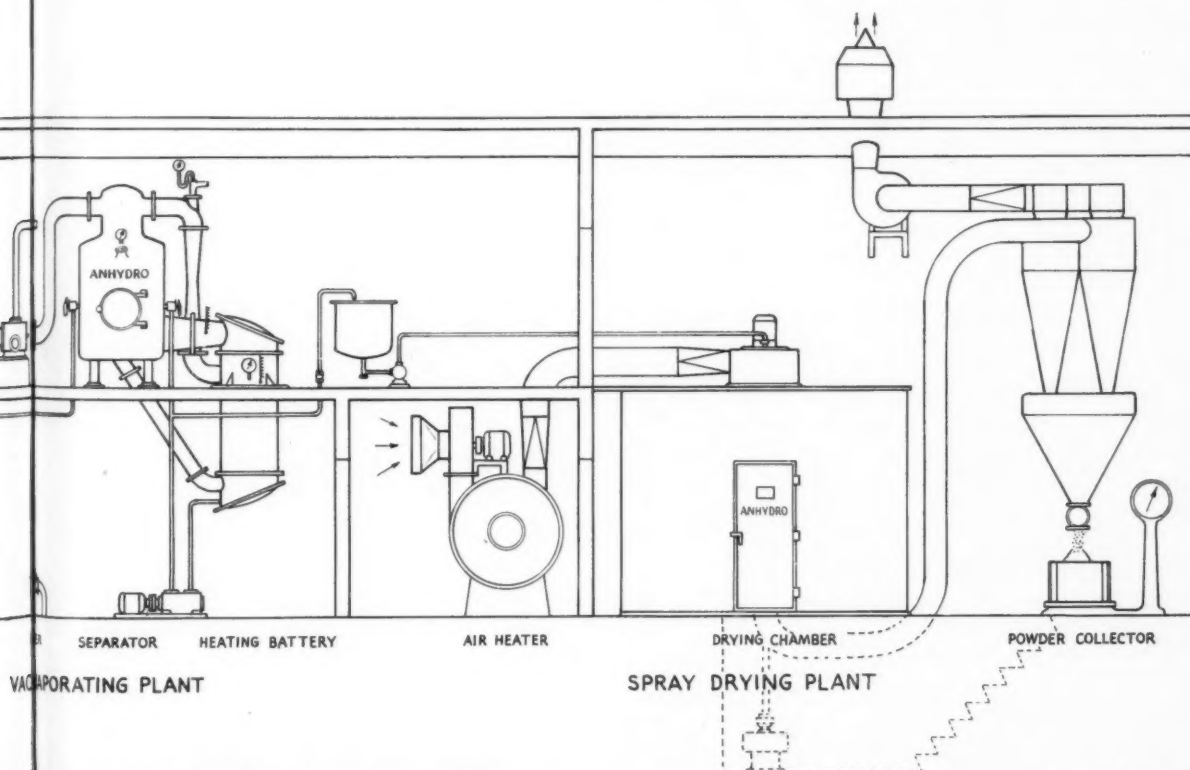
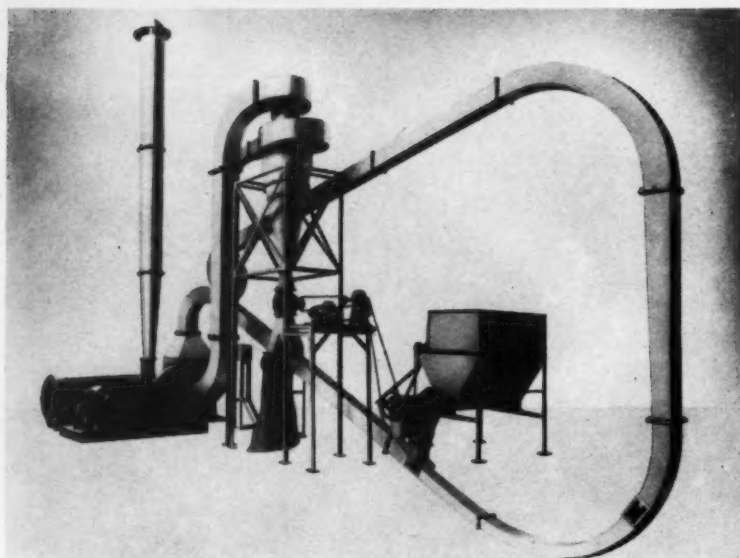


Diagram showing arrangement of blood drying plant using spray drying.

[Courtesy: Anhydro A/S]



Ring drier as used for making dried blood powder.

[Courtesy: F. W. Berk & Co. Ltd.]

system. The temperature of the incoming air is 350°C. and its outlet temperature 60°C. Even if the temperature is high, the material remains still cool as long as it is wet and, as the heat only comes in contact with the wet material, it cannot do harm or cause nitrogen losses. The fuel consumption under these conditions amounts to 1 lb. of oil per 9 to 10 lb. of water evaporated. The moisture content of the final powder is controllable between 5% and 12% by adjustment of the outlet temperature.

The higher the temperature at which drying can be effected the smaller will be the ducts and the whole plant, which will thus be correspondingly cheaper. Although this drier can be worked at lower temperatures, this would necessitate installation of wider ducts and an increase in the dimensions of the plant, involving higher initial costs. Compared with a spray drier, the latter are considerably lower for the pneumatic drier. But where operating costs are concerned, although fuel consumption should also be lower for the pneumatic drier, labour costs are less for the spray drier and, further, there is no need for clotting plant, evaporation of water previous to drying, etc.

Method 4

This method is intended to enable clotted blood to be converted into a good-quality fertiliser by either spray drying or pneumatic drying. To spray dry the clots, they must be

finely dispersed first by passing them through a colloid mill and a fine sieve similar to the one previously described (see under 'General details of processes'). Dependent on the water content of the clots, it may be necessary to add up to 20% water during the process of dispersion. For the purpose of pneumatic drying, the dispersion has to undergo removal of excess moisture by evaporation *in vacuo* to 70% water content. The use of a colloid mill for dispersing the clots is not necessary, as the stirring of the clots in the horizontal drum will diffuse them sufficiently.

Future prospects

To take a look into the future, the interest in plant and processes for the utilisation of animal blood has grown considerably in late years, especially in connection with new projects which foresee the accumulation of large quantities of blood in large central slaughterhouses. It would be fruitless to give an estimate of the quantity of blood produced p.a. and it is easier to calculate the available quantities from the number of animals slaughtered on the basis of about 4 gal. for oxen and horses, 3½ gal. for bulls, 2.65 gal. for cows, 0.75 gal. for calves, 0.66 gal. for pigs and 0.33 gal. for sheep. To arrive at a decision whether or not the processing of blood can be expected to be a profitable proposition, it is imperative to make a close study of local conditions and consider carefully the points which have been laid down earlier in this article.

Tumbling mills and breakage processes

For some years the research department of Edgar Allen & Co. Ltd. has been studying the dynamics of tube and ball mills which are important products of the firm's engineering division. This mathematical work culminated in the presentation of papers to the Mathematical Association and University mathematical societies. A new approach to the problem has recently been made by T. G. Callcott and S. R. Broadbent, who simulated the mechanical operation of a mill by using a mathematical operator in the form of a matrix. Extraordinarily close agreement between the predictions of this method and the actual output of an Edgar Allen cement mill was shown. Callcott, now with the Broken Hill Proprietary Co. Ltd. of Australia, has continued his work on this subject by studies on the grinding of zinc ore and cement clinker and has recently presented a paper on the subject to the Australian Institute of Mining and Metallurgy. This paper includes information and data provided by the research department of Edgar Allen & Co. Ltd. and is to be printed in a forthcoming issue of the company's technical journal. Although the discussion is based on the use of matrix analysis, little mathematical knowledge is required to follow the development of the subjects. An elementary account of the matrix analysis is included as an appendix.

Coal as a raw material

The importance of coal and its by-products in the organic chemical industry will perhaps be more clearly recognised when it is no longer necessary to burn vast quantities of it for the production of energy. The day is not far off, however, when a considerable proportion of our energy requirements will be obtained through nuclear fission, and it is therefore opportune to survey the actual and potential uses of coal for special applications in the hands of chemists and chemical engineers.

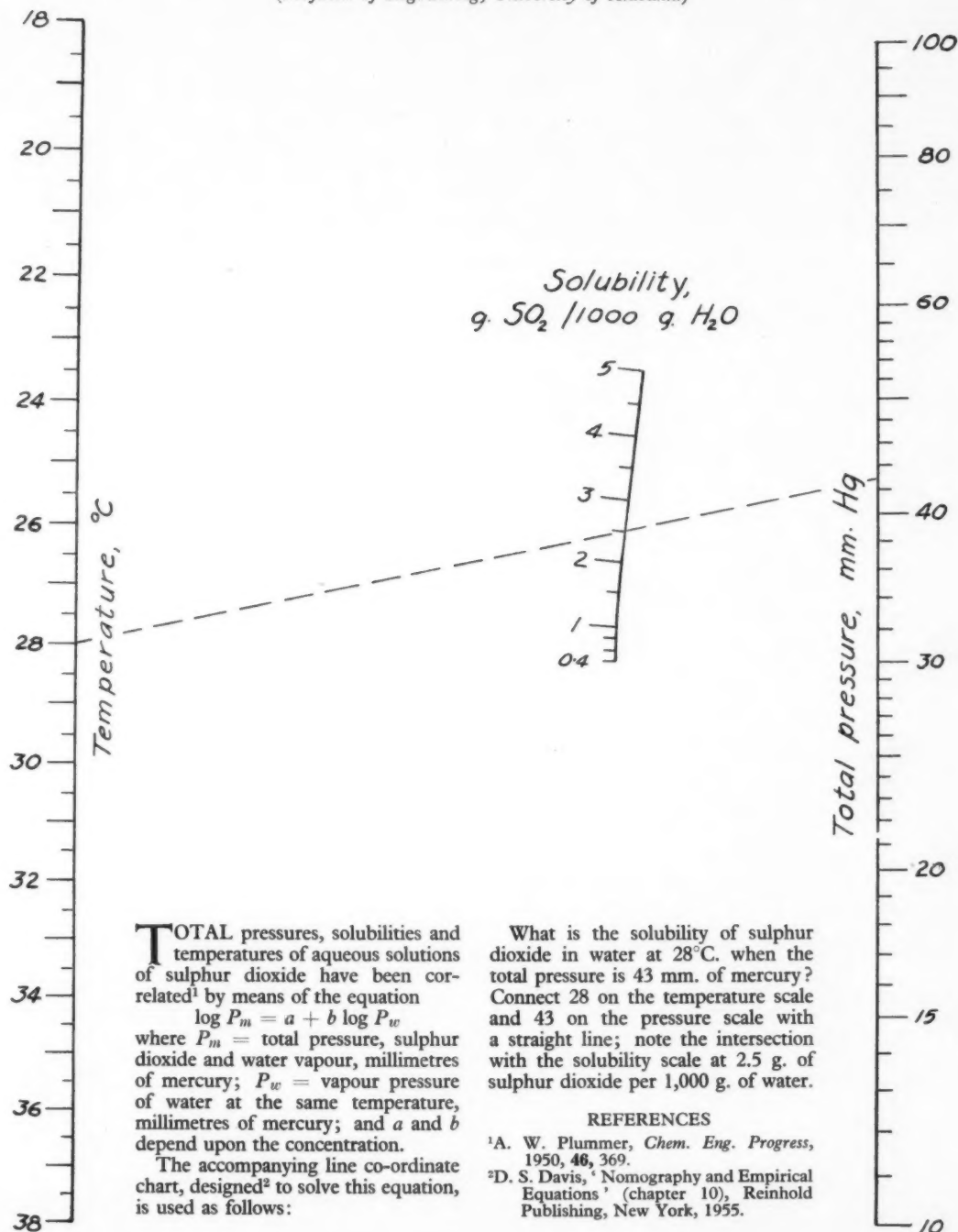
Such a survey, an expanded account of a lecture to the Royal Institute of Chemistry at its anniversary meetings in April 1956, has now been published. The author is Dr. W. Idris Jones, Director of Research, National Coal Board, and copies are obtainable from the Royal Institute of Chemistry, 30 Russell Square, London, W.C.1, at 4s.

Nomogram:

Low-range Solubilities of Sulphur Dioxide

By D. S. Davis

(Professor of Engineering, University of Alabama)



How to Read Engineering Drawings

3. Layout Drawings

By **D. V. Pridham, A.M.I.Mech.E.**

(*Chemical Engineering Department, Costain-John Brown Ltd.*)

This is the third in this series of four articles dealing not merely with the reading of drawings, which in one sense all chemical engineers are trained to do, but showing how ideas can be interpreted through drawings, and how the subject is best approached to secure the maximum co-operation between engineer and draughtsman. In this month's contribution, the author discusses the various considerations affecting plant layout and then gives an actual illustrated example of preparing layout drawings for a simple plant.

LAST month's article dealt with the various types of flowsheets and the production of them. The next logical step is to continue with the planning of a plant layout drawing, as this is the direct expression of the engineering flowsheet.

The purpose of a plant layout drawing is to produce a tidy plant. The plant must be tidy in every sense of the word and many points must be considered to achieve this condition. It is inevitable that some desirable features of layout have to be discarded in favour of more essential requirements. The problem, however, is to be able to recognise all the requirements and to decide on the compromise which will give the best results. By and large it is true to say that this is best decided on the drawing board. Many firms employ layout draughtsmen who are usually possessed with a natural ability to 'see' a plant after studying the engineering flowsheet for a while.

Considerations affecting layout

Essentially plant layout becomes a matter of economic grouping of plant, arranging it so that the minimum of effort and money go into the installation and operation. Certain groupings of plant will immediately suggest themselves from a study of the flowsheet. Relative heights of plant items and the necessity of having associated equipment in close proximity will also become evident.

There are also a number of points which deserve consideration, but which will not appear on the flowsheet. Depending upon the process, the quantities of raw material and finished product will play a significant part in the siting of the prime and final processing equipment. If these quantities are large the siting of these items near the delivery, storage and despatch areas will be a prime requirement. Main effluent may also play a determining part in the siting of certain equipment if there are large quantities for disposal. Such conditions are frequently imposed by the site conditions such as road, rail and main drainage access.

Plant running conditions will have an effect on the grouping of plant. It is important that such maintenance as is necessary can be done with reasonable elbow room.

It is known that inaccessible items always get less than their fair share of maintenance. In addition to this it should always be made possible for sections of a plant, which will require maintenance, to be easily moved out so that routine overhauls can be made in the plant workshops.

Installation access is not often overlooked as too many people have found or heard of the misfortunes of those who had to dismantle a plant to get the last item in. What is more common, however, is the trust that is placed on delivery promises. Although an item may be scheduled to appear on site to fit an erection programme, it is sad to relate that only the super-optimistic really believe the schedule. The cost of having plant erectors idle, waiting for delivery of a major component, is an eloquent plea for the layout draughtsman to endeavour to design a plant with several alternative erection schemes. This, too, will have its effect on the grouping of plant.

Plant control, capital outlay and other considerations

Plant control should also have an influence on the grouping of equipment. Careful planning can save an appreciable amount on labour costs and in these days of high costs can be a major design feature. Clearly, associated plant equipment requiring process attention should be grouped to enable the necessary operations to be gone through without having to walk too far. The advance of materials-handling design has made it much easier for this to be done and full use should be made of the wide range of equipment available in this field. The advantage of a central control area has been stressed by many, but it is as well to remember that an additional advantage can be gained if the plant is so grouped that equipment being operated from the control centre can also be seen from there. It is perhaps a minor feature, but nevertheless a desirable one.

Capital outlay can be substantially reduced by astute grouping of plant. In addition to reducing the amount of pipework involved, it is possible to save a considerable amount of money on supporting steelwork and super-

structures. The flowsheet will indicate the relative heights of equipment, but it is frequently possible to juggle with vessels' heights, sometimes with the addition of an odd pump or two, so that the number of levels is reduced to one or two. Having located these in a few planes in the vertical sense, it can then be possible to collect them in one area and support the lot on a simple structure. The saving is considerable. Finally, the cost of housing the plant in a building will benefit by careful grouping both in plan and elevation.

There are obviously many other factors affecting plant layout such as health and safety hazards, working conditions affected by noise, fumes, dirt and smoke, all of which will have an effect on plant layout design. The good layout draughtsman will be aware of these and will endeavour to lay out his provisional schemes bearing them in mind.

It is unlikely that a layout can be produced which will satisfy all these requirements, although to obtain a satisfactory result it will have been necessary to have considered each case on its merits.

The selective grouping of plant will therefore be largely influenced by the considerations listed below:

- (1) Proximity of raw materials to plant intake.
- (2) Proximity of despatch facilities to finished product stage.
- (3) Proximity of main effluent disposal to sources.
- (4) Maintenance access.
- (5) Installation access.
- (6) Process control and operation.
- (7) Control point observation.
- (8) Pipework economy.
- (9) Supporting structure economy.
- (10) Platform and superstructure economy.
- (11) Materials- and plant-handling equipment.
- (12) Building size and disposition.
- (13) Health and safety, working conditions etc.

Producing the plant layout drawing

Of the above list, items 1 to 8 can be considered with the aid of a rough plan. It will require a little imagination to bear in mind the relative heights of equipment. It is usual, therefore, for the designer to start his first thinking on the layout by considering the plant in plan. He will produce initially a drawing to small scale using simple rectangles and circles to represent the major items of plant. These he will arrange to satisfy very broadly items 1, 2, 3, 5, 6 and perhaps 7. It is not unusual to produce several alternatives at this stage so that they may be fully discussed with the engineers. Following this will come a slightly larger-scale drawing, still using rectangles and circles to represent plant, and including two or three selected elevations. With this drawing it is possible to give more detailed consideration to the original items and to include items 9, 10, 11, 12 and 13. The major discussions should take place at this stage, because it is here that the basis of the whole plant layout is determined. More often than not the size and shape of building is settled and this usually has the effect of finalising the disposition of main plant items.

Having settled on this broad basis of the layout, outlines more representative of the final shape of plant equipment are produced on a similar-scale layout. At this stage the detailed layout of the plant often stops while detailed designs of equipment are produced to be sent away for manufacture or procurement. There is, however, sufficient information on the layout for designers to establish where to put pipework connections, detail roughly pipework runs, supporting lugs, supporting steelwork, access gangways, cranes, hoists, materials-handling equipment etc.

This preliminary layout then enables the detailed design

work on the plant to proceed unhindered. As each item of equipment is designed or specified, the details as far as they affect layout are discussed with the plant layout draughtsman before manufacture.

When sufficient plant details are available, the preparation of the final layout drawing will commence. It may be sub-divided into a number of sub-layouts, depending upon the complexity of the plant.

In the simple case the layout draughtsman will in fact build the plant in pencil on his drawing. This operation will bring to light the discrepancies (which usually exist) before the design has gone too far. The experienced draughtsman will know exactly how much detail to allow on his drawing. It is not unusual for a plant layout drawing to confine itself to positioning the plant items in their supporting structure without trying to show such things as pipework or plant handrailing (which so often gets confused with the smaller pipework). Sometimes a plant layout will show only the major pipework, leaving all service pipework off.

With all drawings there is a limit to the amount which can be read off them and a great deal of self-control has to be exerted in their preparation. To the draughtsman producing the drawing the detail shown is always so much clearer than to anyone reading it. An effective method of showing pipework on plant layout drawings is to indicate the pipework by single lines. The lines may be differentiated by using varying thicknesses or 'chain dotting' as in the flowsheet technique. Where this is adopted it is sound practice to use the same weight of line as used on the flowsheet, so that pipework may be more readily identified with the flowsheet.

Similarly, valves and fittings may be represented by flowsheet symbols, although these should be drawn to a scale sufficient to occupy the space which the true scale drawing of the fitting would take. More properly, however, pipework should not appear on a plant layout drawing in detail. This should be reserved for the pipework layout drawing. It is sufficient to indicate the route and the space which will be occupied by pipework on the plant layout drawing.

Pipework layout drawings

These drawings must confine themselves to giving all the details required to pipe up the plant. Because of this the plant items are frequently shown in a relatively faint line to add emphasis to the pipework detail.

It is not necessary to draw the pipework in true scale, although this is still quite common practice in Britain. Nor is it necessary to show pipework fittings and valves in detail. Modern practice is to indicate pipework runs as suggested above in single line, giving representative symbols to scale for fittings and valves. In the case of heavy pipe the positions of pipe supports will be given, but in the case of small-bore pipework this is usually left to the discretion of the erector, after giving a general note about the maximum size of pipe.

Details of flanged or screwed connections may also be given, although this too is optional and is frequently given in a written specification.

The class and bore of the pipe, including its contents and pressure, will always be given and, in the case of pressure pipes, the class and type of flanged joint and fittings will be covered, either by a note on the drawing or in the pipework schedule.

Preparation of layout drawings for a simple plant

For the sake of illustration a simple plant consisting of

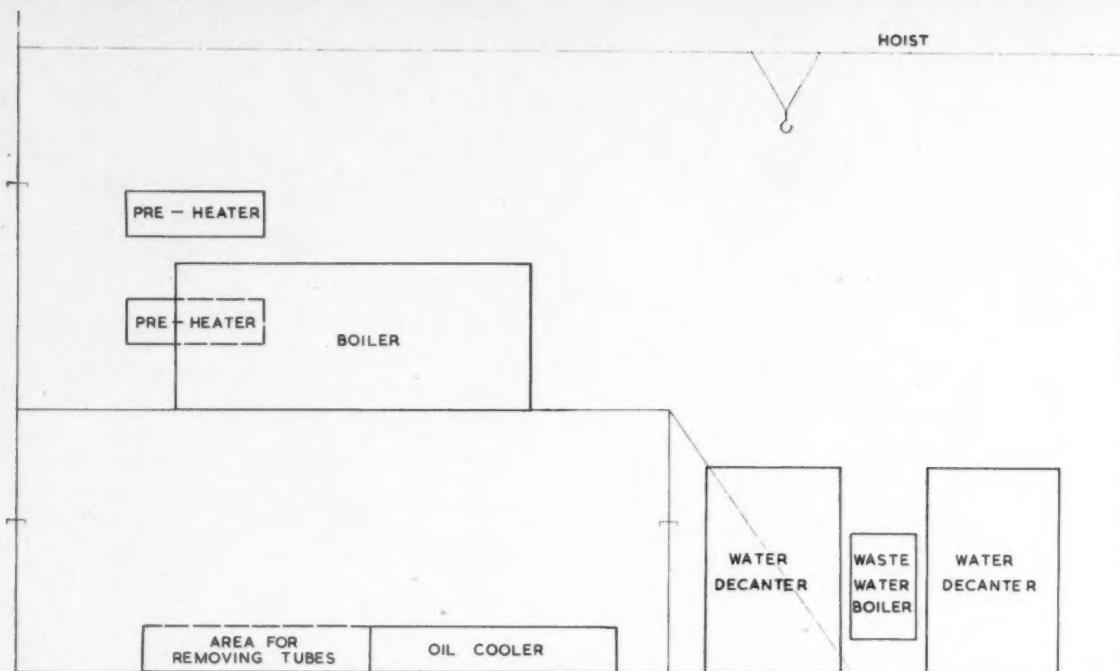


Fig. 1. Preliminary layout (elevation only) of a boiler installation showing disposition of main components.

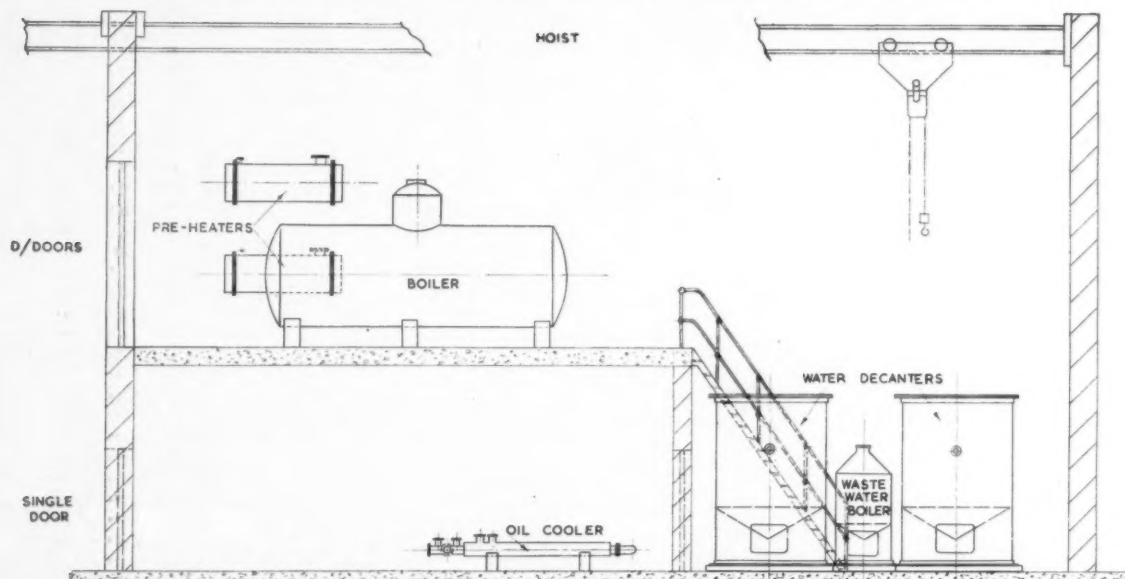


Fig. 2. Plant layout drawing follows the preliminary layout shown in Fig. 1.

only eight items has been selected. The flowsheet is not reproduced, but it is sufficient to say that the only requirement shown on this is that the boilers have a fixed head and that the remaining items should be at floor level.

Before commencing the preliminary layout (Fig. 1) the draughtsman has examined the typical plant items and discovered the following points. The waste-water boiler and water decanters will require process changing of their internals. The oil cooler will require frequent removal of tubes and the main boilers will also require occasional

cleaning of the boiler tubes. He has discovered that the first three items will require vertical removal of internals and the remainder can be dealt with horizontally.

From this information he produces a schematic plant layout (Fig. 1). On this he indicates the proposed layout. This clearly indicates the room for access with regard to the maintenance requirement providing a conveniently placed travelling hoist for removal of the heavy-water decanter internals. This he arranges to facilitate the installation of the boilers when the plant is being erected.

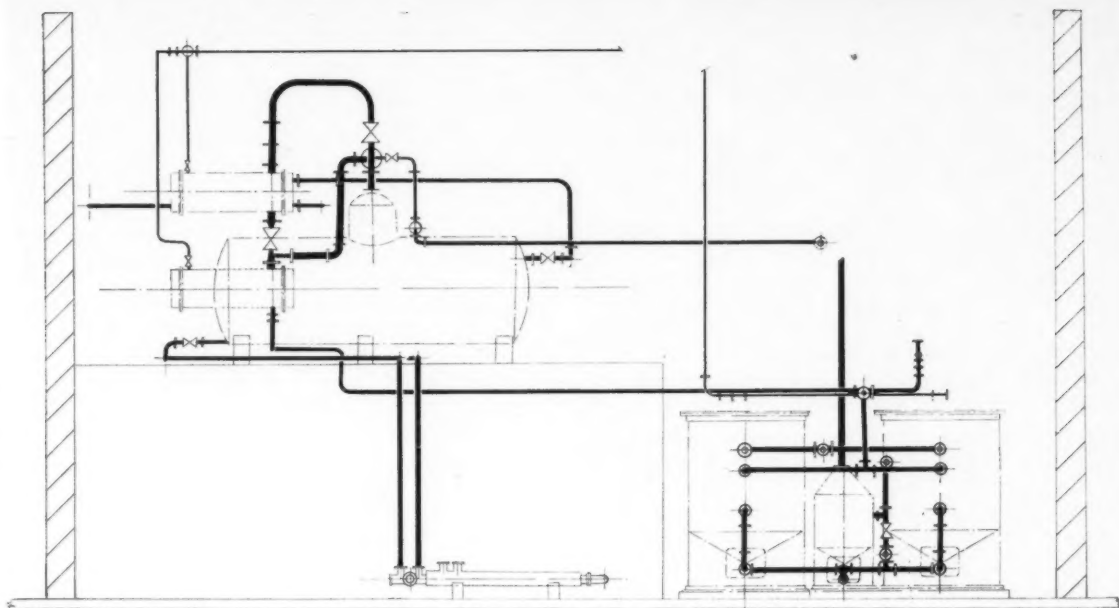
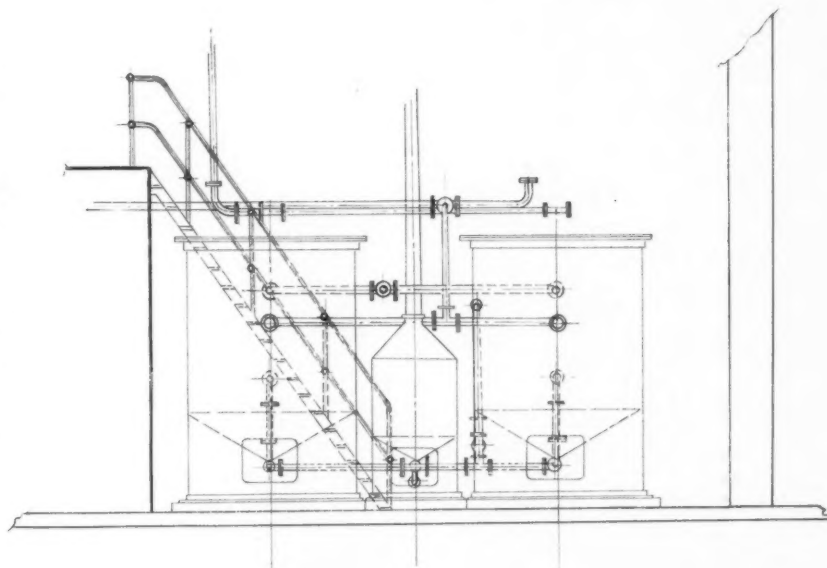


Fig. 3 (above) shows pipe-work drawing for same plant as shown in Figs. 1 and 2, while Fig. 4 (right) shows the confusion that can arise when the method illustrated in Fig. 3 is not used.

(It should be noted that, while the illustrations on these two pages show elevations only, the plan of the proposed plant would also normally be shown on the layout and pipework drawings.)



The boilers are also placed near the main doors, as these items will probably be on long delivery and will arrive last.

When the schematic arrangement is approved the plant layout drawing (Fig. 2) is produced. This gives shape to the rectangles and circles and positively positions them. On this drawing would go the dimensions for fixing the positions. These have been omitted for clarity in this instance. From this drawing all the necessary structural detailing can commence and it will enable the plant pipework drawing to be produced.

On the pipework drawing (Fig. 3) it will be noticed that the plant items are shown in interrupted line so as to give emphasis to the pipework details. The pipes are shown in solid black lines, and the valves as symbols. The stair railing is omitted to avoid confusion. There are many

different schools of thought on the advisability of using this technique. In the author's opinion it is by far the clearest method.

An illustration of the decanter section using the more conventional method of drawing gives an indication of the amount of confusion which can exist even on a simple layout such as this (Fig. 4).

The pipework layout would have included on it a reference to each line to identify it with a piping and valve schedule. It would also be read in conjunction with the engineering flowsheet. Between these four drawings the exact specification of each pipe, valve and fitting should be obtained. Because of this it is important that there is the minimum of duplication. On a simple layout such as this the preparation of a pipe schedule may not be con-

sidered worth while and in this case the information would be included on the pipework drawing. In the case of a more complex plant it is probable that the layout would be made in several sections and that the pipework drawings would confine themselves to a few services per drawing. If large pipework was included, most of it would require prefabrication. This would entail the production of pipework detail drawings and, in this case, reference to these would appear on each section of the pipework layout.

Changing trends in drawing technique

The number of different ways of producing plant and pipework drawings is extremely large. It is also true to say that almost every conceivable method is in use today. Some are dying out and others gaining favour. The illustrations chosen are of the latter type. The days when there was sufficient time to produce a drawing which was a picture of the finished plant have passed. Each new drawing technique is aimed at reducing the time taken for a drawing and, as the most time-consuming

drawings are plant and pipework layouts, it is not surprising that these are the main subject of experiment.

Fortunately there is one criterion which will remain unchanged. If a drawing departs from projection laws or contains so much information that it is difficult to read, then it is a bad one. Very few engineers can pick up a layout drawing produced by a strange drawing office and understand it instantly. They have to explore the drawing using their knowledge of draughting rules to grasp its general meaning. After a while it will become apparent to them which techniques the draughtsman has adopted. From then onwards the reader can easily understand his drawing. It is essential, however, that the drawing obeys the rules for its reader to begin to understand it.

There is no reason, therefore, to be dismayed if, at first sight, the layout or pipework drawing appears to be a mass of unintelligible lines. Read it slowly, fixing landmarks of projection on it and the rest will gradually, but surely, become clear. If it does not, then say the drawing is bad. You will probably be right.

LARGE-SCALE NITROGEN PURIFICATION

WITH the start-up recently of the British Oxygen Co.'s new air-liquefaction plant at Middlesbrough, the largest Deoxo purifier so far installed in this country went on stream.

One of the functions of this modern plant is to supply high-purity nitrogen to the nearby Wilton works of Imperial Chemical Industries, and B.O.C., after considerable experience with Deoxo gas purifiers in their various plants throughout the country, decided to use this process for removal of residual oxygen before piping the pure nitrogen to Wilton.

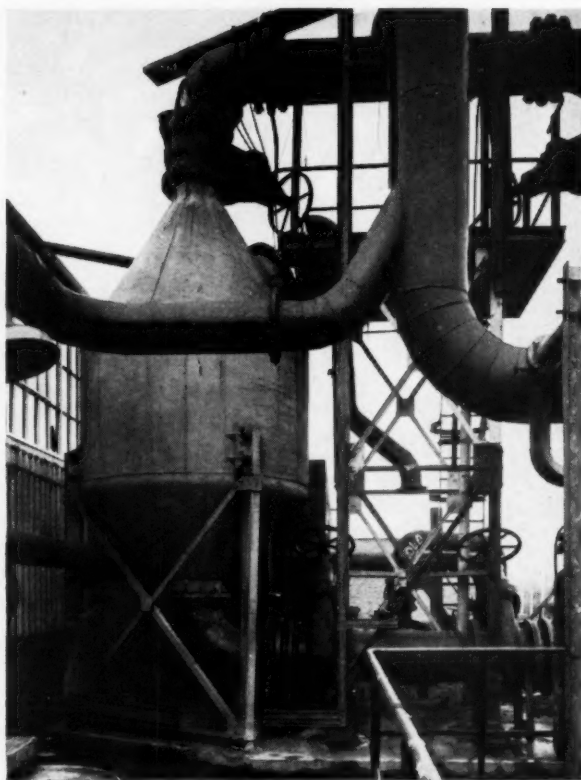
The Middlesbrough Deoxo unit is capable of purifying very large quantities of nitrogen and, according to performance data so far available, the level of oxygen remaining in the gas after purification is well within the specification guaranteed by the manufacturers. This 'D'-type purifier is designed for the continuous removal of molecular oxygen from nitrogen by combining it with hydrogen to yield water vapour; the combination is effected over a precious metal catalyst which is highly active at room temperature, the water vapour formed being removed in a standard drier.

Other types of Deoxo purifier allow for selective combination of oxygen with hydrogen in the presence of carbon monoxide, oxidation of carbon monoxide to carbon dioxide, oxidation of hydrocarbons to carbon dioxide, hydrogenation of carbon monoxide to methane and selective hydrogenation of acetylene in ethylene.

Although this purifier is the largest of its kind so far on stream in the U.K.,

larger units will be in use shortly and comparable units have been in operation on the Continent for several years. The manufacturers of the Deoxo gas-purifi-

cation equipment—Baker Platinum Division of Engelhard Industries Ltd.—are currently working on designs for purifiers with capacities up to 2 million s.c.f.h.



View of the Middlesbrough installation

Speeding Up Handling of Chemical and Medicinal Products

MODERN METHODS FOR WINTHROP LABORATORIES GROUP

This special 'free lift' truck is so constructed that the forks can be raised 6 ft. before the overall height of the truck is increased. It is seen here working in a narrow aisle at the store of Tyneside Tin Printers Ltd.



THE new premises of Winthrop Laboratories Ltd., on the northern outskirts of Newcastle, designed for group processing of chemical and medicinal products, provide an example of modern planning incorporating the latest machinery and served by a progress system devised with the most efficient materials-handling aids in mind.

Four well-known groups of products—Andrews' liver salt, *Delrosa* rose-hip syrup, California syrup of figs, and Phillips' milk of magnesia and tooth-paste, together with ethical products—are linked under the Winthrop Group administration, but are at present manufactured separately in widely distributed works. The new premises will not only offer opportunities for centralisation of services, but will provide increased production facilities under conditions of strict hygiene and quality control.

The north side of the new site is bounded by a railway, and the east by a road and, in the angle formed by these two means of access, the two established buildings are situated. These are the works of Tyneside Tin

Printers Ltd. and Winthrop Laboratories' tin-box works. The first serves the second with printed tin plates of all descriptions. Both these sections carry out tin-box production under contract to other well-known companies outside the Group.

The Winthrop Laboratories' tin-box factory is linked by a conveyor system with the new works growing to the west and south, the first segment of which will be devoted to production facilities for their largest 'internal' customer—Andrews. The four sections of the new factory, starting from the eastern end, will be those for Andrews, Phillips, the liquid products and the ethical products.

At the time when this article was in preparation, the first of these sections was at the stage of advanced experimental production, and warehousing was being set up for the Phillips' section. A materials-handling system based on the use of standard electric trucks was already taking shape.

Materials reception and storage

Materials will arrive by road or rail at the north side, many of them

already palletised on Winthrop Laboratories pallets. Others will be palletised immediately. Two pallet types are standard: a 40 in. × 48 in., two-way-entry, flat wooden type, and the Fisher & Ludlow *Flowtief* pallet of the same dimensions, adaptable readily to flat, post, post-and-tiebar or post-and-wire mesh versions with simple accessories. Experimentally, post tops on these pallets are being finished red to aid location during stacking. Sugar, used in large quantities in the manufacture of Andrews', is stored in aluminium-alloy tote bins.

Apart from sugar, the first section of the materials warehouse contains bicarbonate of soda, epsom salts, tartaric acid and 10 kinds of fibre container stored flat. Two months' supplies of materials will be held in all sections.

Fork trucks and pallet trucks

Stacking in the warehouse is carried out by electric rider-controlled fork trucks with 14-ft. lift, giving stacks of four pallet loads 18-ft. high. The fork trucks are allotted to each section exclusively, and are reserved for load-

ing and stacking duties. Horizontal movement is carried out by a fleet of Lansing Bagnall model PP 230 pedestrian-controlled pallet trucks which accept loads from the fork trucks directly they have been unstacked, and transport them to the production areas through sprung-rubber-curtain doors. Circulation areas are clearly defined, all stacking blocks being marked with white chequerboard outlines on the floor. Main aisles are 12-ft. wide and intersecting aisles 10 ft.

In the case of the tote bins—stackable patent bulk containers—the PP 230 has only to take the bin to a special tipper which empties its contents into hoppers feeding the processing plant. In other cases loads of bagged material are delivered direct to the point of use, and access to machines has been planned on the basis of the PP 230's manoeuvrability and compactness; this model is, in fact, only 17½ in. longer than the load it carries (or, when running unloaded, than its own 40-in. forks). One PP 230 will be stationed at the raw materials end of each producing section, and the electric trucks will be covered in case of sudden peak demands by stand-by hand pallet trucks.

When all product groups are in operation, the raw materials side of the building will contain as many as 1,000 different articles in store, in an area 590 ft. long × 100 ft. wide.

Handling finished goods

Pallet trucks and fork trucks will also be permanently stationed at the finished-goods side of the building—a warehouse measuring 590 ft. × 80 ft. and linked like the raw-materials warehouse to the production areas by

self-closing rubber doors. Model PP 230 pallet trucks will pick up pallet loads made up beside the cartoning machines and transport them to the finished-goods warehouse for fork-truck stacking in pallet blocks marked on the warehouse floor. Special hatched areas of floor will be left free for the assembly of consignments being drawn from store for shipment by road. When full production is achieved in about 12 months' time there will be as many as 1,500 different packs in store at the finished side.

New stacking development

Though the sections at present operating are organised for stacking by rider-controlled electric fork trucks of high capacity, the last section—that for ethical products—will be laid out for stacking by Lansing Bagnall model SFR 225 reach fork truck, a new development in stacking trucks whose retractable mast and fork assembly dispenses with the conventional counterweight system, enabling the machine to work in aisles as narrow as 5 ft. 6 in. Economy of circulation space on this scale is made necessary by the multiplicity of packs in the ethical production schedule. Each of these must be handily placed for shipment, so that stacking in depth is out of the question unless fork trucks are to double—or even treble—handle items on outside stacks. Shallow stacks surrounded by many narrow aisles are, therefore, envisaged and the SFR 225 is stated to be the only truck capable of carrying out this stacking task. The models supplied will have maximum lift of 14 ft.

'Free lift' reach truck

A special version of this type of

truck, incorporating the novel 'reaching' mechanism already described but so constructed that the forks can be raised 6 ft. before the overall height of the truck is increased, has been responsible for space economies in the tinplate pack store at Tyneside Tin Printers Ltd. Here, briefly, standard 1-ton tinplate packs on wooden stilts arrive by rail beside a loading dock on the north side. They are unloaded and transported to store by a Lansing Bagnall model PPT truck, a pallet truck with forks of dimensions specially suited to tinplate handling.

The 'free lift' reach truck accepts these loads and stacks them ceiling-high, two deep on one side of a narrow aisle and three deep on the other. Introduction of the SFR enabled the third row of packs to be added, and its high free lift added another layer to stacks which had only been built six high using a conventional fork truck, a storage increase of about 40%.

Waste and other heavy packs are horizontally handled by one of the two model PPT tinplate pack trucks, which serve in the machine shop of the tin-box factory as well as in the tinplate store.

Safety and other facilities

Great care is taken at Winthrop Laboratories to regulate the operation of materials-handling trucks for maximum efficiency and safety. In the new premises, for instance, special floors have been laid to give smooth running and resist abrasion by the trucks' wheels. The pallet trucks have been fitted with new-type fibre wheels, which it is thought may show advantages over the standard steel wheels in operation on the special surfaces.

A generous area at the north-east corner of the new building is set aside for the service of materials-handling trucks, where wall chargers can keep spare sets of batteries in readiness and where the Lansing Bagnall trucks fitted with built-in chargers can be plugged in each night to the a.c. mains supply. Every truck has its station allotted within this service area.

Orange and black stripes have been adopted as standard finish for all trucks, and these safety colours are repeated on steel angle guards placed protectively at the corner of each pallet stack.

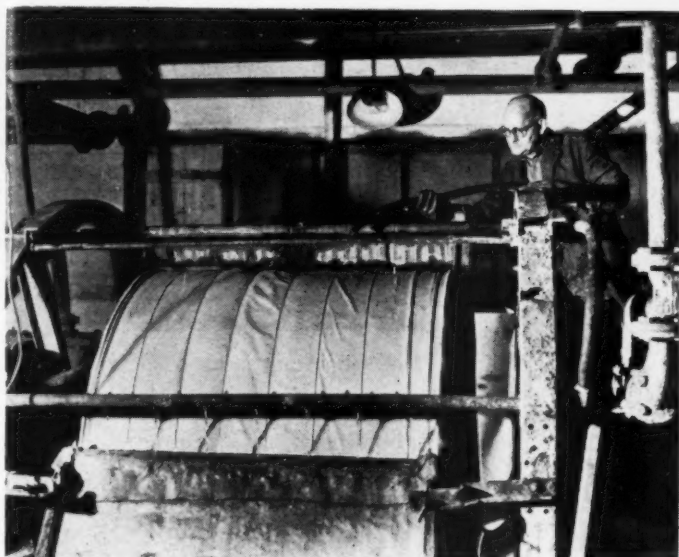
Drivers of fork and pallet trucks—including a number of girls who take readily to operation of the pedestrian-controlled types—are given a two-week training course followed by a test before their factory driving licence is issued.



Here in the new raw materials warehouse of the main Winthrop Laboratories premises, a 2,500-lb. load of bagged tartaric acid is being handled. In the background can be glimpsed the truck service bay with standby machines.

'Terylene'

in Filtration Processes



THE man-made fibre *Terylene* is being successfully used today for a wide range of filtration processes, from phosphate manufacture to milk processing in modern dairies. The special properties which make it suitable for use as a filter medium include high strength—wet or dry; excellent resistance to mineral and organic acids, oxidising agents and solvents; good resistance to most alkalis, especially when cold; excellent resistance to dry heat up to 150°C. for long periods; immunity from bacterial attack; abrasion and flex resistance; little or no shrinkage during use, and ease of cleaning and cake removal.

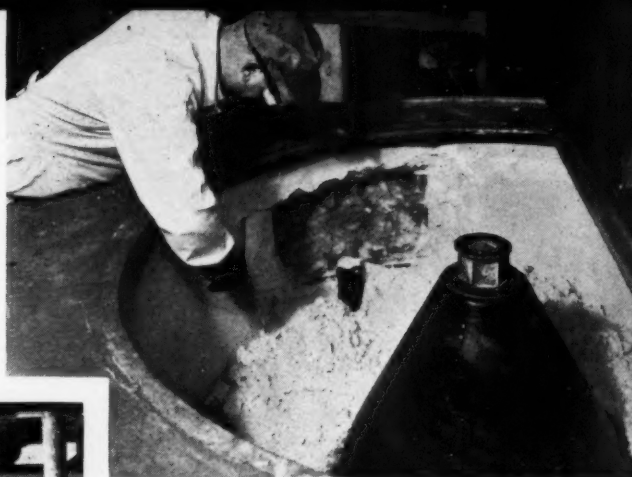
It is in acidic or heat conditions that *Terylene* really comes into its own and the fibre's excellent resistance to acids (e.g. no loss of strength after immersion in concentrated phosphoric acid at 80°C. for 72 hr.) prompted a large U.K. manufacturer of dyestuffs to consider its use in acidic processes. The increased life obtained offsets the higher initial cost of *Terylene* to such an extent that the firm now save thousands of pounds annually.

Another example of great increase in life is in the filtration of a sulphuric and hydrochloric acid mixture. The usual cloth lasted 15 filtrations while *Terylene* was still usable when the trial was completed after 707 filtrations.

In the field of hot gas filtration *Terylene* cloths are being widely used in the reclaiming of certain valuable dusts from gases resulting from smelting of metals. Apart from the direct economy resulting from reductions of cloth usage, the saving in production time, afforded by less frequent replacement of the many filter bags in the large dust extraction units, is also considerable.

Made in two forms—continuous filament yarn and staple fibre—*Terylene* can be woven into fabrics ranging from the finest bolting cloth to the heaviest duck. Fabrics can,

This press is in use filtering an organic acid sodium salt, used in dyestuffs manufacture, at a temperature of 70°C. at 30 p.s.i. pressure with 3 to 4% sulphuric acid present. As in the picture at the top of the page, 'Terylene' protective clothing is being used by the operative.



▲ This equipment is used for carrying out the filtration of an organic sulphuric acid, an intermediate used in the manufacture of dyestuffs, with 50% sulphuric acid present at approximately 30°C. Use is made of the high resistance of 'Terylene' to acid conditions and although the cost is three times that of woollen cloth, the life is at least 20 times as great. The filtration fabric can be seen inside the hydro-extractor.

◀ In this knife-discharge rotary filter a suspension of ferrous sulphate monohydrate in 50% sulphuric acid is being filtered at a temperature of 55°C. 'Terylene' was used because of its high resistance to degradation in acid conditions and also because the initial cost of the fabric was some 50% less than previous synthetic fabrics which had been used. A 'Terylene' brattice cloth is also used beneath the filter cloth.

therefore, be specially designed to filter a certain particle size or to allow a predetermined rate of flow. Some of the processes, besides those already mentioned and illustrated here, where *Terylene* cloths are being successfully used are gypsum filtration in a phosphate plant, yeast extracting in breweries, oil seed crushing, uranium filtration, sugar manufacture and in reclaiming starch dust.

Terylene is manufactured by I.C.I. Ltd.



RECENT PUBLICATIONS

Upgrading inedible fats. Bleaching of inedible fats with chlorine dioxide is discussed in a new 12-page illustrated booklet issued by the industrial chemicals division of Olin Mathieson Chemical Corporation, Baltimore 3, Maryland.

The booklet describes methods of purifying tallow and other inedible fats and protecting them against deterioration, chlorine dioxide bleaching of tallow by the dry gas and wet methods, and a procedure and apparatus for determining the effectiveness of chlorine dioxide as a bleach.

Electro-deposition of metals. A 28-page reference book on this subject has been published by Fescol Ltd., North Road, London, N.7.

Industrial trucks. A revised edition of a publication on 'How to Select Industrial Trucks' discusses the various factors involved in selecting the correct industrial truck for a

specific plant. This new edition is illustrated and includes references to the variety of attachments available for fitment to fork lift trucks. Copies are available from the Yale & Town Manufacturing Co., Wednesbury, Wolverhampton.

Heat exchangers. Ashmore, Benson, Pease & Co., Parkfield Works, Stockton-on-Tees, having concluded an agreement to manufacture tubular heat exchangers designed and rated according to the principles established by C. F. Braun & Co., of California, U.S.A., have now published a fully illustrated 32-page booklet on Braun standard heat exchangers. The five basic types are described in detail and shown in pictures and cross-sections. The use of each and the differences between the five types are explained. The reasons for certain special features in the design of Braun heat exchangers, such as the throughbolted floating-

heads, annular distributors and solid metal gaskets, are given, and the booklet ends with photographs of heat exchangers in various applications, including a fluid 'cat' cracker, a chemical plant inter-cooler and an ethylene condenser.

Pigment softening and flushing. Technical bulletin No. L-20, published by Armour chemical division, Lindsey Street, London, E.C.1., describes a range of chemicals for various pigment softening and flushing applications. One of these, *Armeen Z*, an ampholytic surface active agent, is the subject of technical bulletin No. L-19, where its properties and further uses as a germicide and in detergents and cosmetics are described.

Nitrogen generators. Holmes-Kemp machines of this type are described in detail in a pamphlet published by W. C. Holmes & Co. Ltd., Turnbridge, Huddersfield.

British Standards

Flash-point determination (B.S. 2839: 1957, 3s. net, 'Determination of closed flash-point of petroleum products by means of the Pensky-Martens apparatus'). Technically identical with the Institute of Petroleum publication IP/34/57, this new standard describes in detail the Pensky-Martens apparatus used for determining the closed flash-point of petroleum products having a flash-point above 120°F. The methods of preparing the sample and of carrying out the determination are specified in detail. The standard also gives some information on the degree of precision which can be obtained, and a note on the correct interpretation on the terms 'repeatability' and 'reproducibility.'

Vulcanised rubber tests (B.S. 903: 1957, Part A4, 3s., Part A9, 5s., Parts D1 and D2, 2s. 6d., Parts E1 to E6, 5s. net, 'Methods of testing vulcanised rubber'). Part A4 of this revised standard deals with determination of compression stress-strain, while the principal new feature of Part A9 is the inclusion of a method of testing under conditions of constant torque, using the Du Pont abrasion machine. Additionally, the layout has been aligned with that of other parts, and metric equivalents have been included. Parts D1 and D2 specify methods for the determination of

plastic yield of ebonite. The sections of the two parts deal with the shape and dimensions of the test pieces, the nature of the apparatus, working procedure, and method of reporting. The publication of parts E1 and E2 is designed to fill the need for methods of testing cellular ebonite. The subject matter of the parts in order covers apparent density, plastic yield temperature, plastic yield at a specified temperature, tensile strength, compression strength, and impact strength.

Solvents and plasticisers (B.S. 509: 1957, 3s. net, 'Acetone'; B.S. 549: 1957, 2s. 6d. net, 'Diacetone alcohol'; B.S. 552: 1957, 3s. net, 'Amyl acetate'; B.S. 574: 1957, 2s. 6d. net, 'Diethyl phthalate'; B.S. 577: 1957, 3s. net, 'Hexachloroethane'; B.S. 663: 1957, 3s. net, 'Ethyl lactate'; B.S. 1595: 1957, 3s. net, 'Isopropyl alcohol'). The issue of these seven further revised standards in the series dealing with solvents, plasticisers and allied materials has been announced. Changes in the specifications reflect improvements in the qualities of material now available; and considerable clarification has been achieved in the presentation of the analytical methods.

Coal and coke testing (B.S. 1016, Part 1: 1957, 3s. 6d. net, 'Methods for the analysis and testing of coal and

coke'). This revised standard is to be published in separate parts, each dealing with a particular group of analyses. Part 1 deals with the determination of the moisture in the coal 'as sampled.' Each of its sections relates to a sample of given particle size, and applicable methods are specified in sub-sections.

In the distillation method for the $\frac{1}{2}$ -in. sample, toluene has been substituted for petroleum distillate of 150 to 180°C. boiling range, as it has been found that petroleum distillate can give higher results due, possibly, to the evolution of water of hydration from the mineral matter or to the decomposition of the coal at elevated temperatures.

Compressed asbestos fibre jointing (B.S. 2815: 1957, 3s. net). The third in what is now a group concerning related products, this new standard was prepared under the authority of the Mechanical Engineering Industry Standards Committee.

The publication deals with two grades of compressed asbestos fibre jointing: grade A for use with water, inert gases, inert liquids or steam up to 950 p.s.i. and 950°F. (67 kg./sq.cm. and 510°C.); and, grade B for use with water, inert gases, inert liquids or steam up to 250 p.s.i. and 450°F. (18kg./sq.cm. and 230°C.).

ENQUIRY CARD

To obtain further information about plant, equipment, materials and services mentioned in this section, simply fill in this card, giving the reference numbers of the items in which you are interested, and post it

Please send information to:	Ref. C.P.E./	Ref. C.P.E./
Enquirer's name <i>(Block capitals)</i>	Ref. C.P.E./	Ref. C.P.E./
Position	Ref. C.P.E./	Ref. C.P.E./
Company	Ref. C.P.E./	Ref. C.P.E./
Business or Profession	Ref. C.P.E./	Ref. C.P.E./
Address	Ref. C.P.E./	Ref. C.P.E./
.....	Ref. C.P.E./	Ref. C.P.E./
.....	Ref. C.P.E./	Ref. C.P.E./

ADVERTISING ENQUIRY CARD

Please send information to:

Enquirer's name _____
(Block capitals)

Position

Company

Business or Profession ☐

Address
.....

Send Technical Information	
Send Representative	
Send Sample	

To obtain further information about plant, equipment, materials and services mentioned in advertisements, simply fill in this card, giving the names of the companies in which you are interested, and post it.

Please state month of issue

[illegible]

*Postage
will be
paid by
Licensee*

*No Postage
Stamp
necessary
if posted
in Great
Britain or
N. Ireland*

BUSINESS REPLY CARD
Licence No. WD 129

**CHEMICAL & PROCESS ENGINEERING,
Enquiry Bureau,
Stratford House,
9 Eden Street,
London, N.W.1**

*Postage
will be
paid by
Licensee*

*No Postage
Stamp
necessary
if posted
in Great
Britain or
N. Ireland*

BUSINESS REPLY CARD
Licence No. WD 129

**CHEMICAL & PROCESS ENGINEERING,
Enquiry Bureau,
Stratford House,
9 Eden Street,
London, N.W.1**

WHAT'S NEWS *about*

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

- ★ Plant
- ★ Equipment
- ★ Materials
- ★ Processes

Countercurrent extraction

Laboratories concerned with countercurrent liquid/liquid extraction will be interested in a machine now on the market which is easy to operate and maintain, both as regards the mechanism and the glass components.

Basically the machine consists of a frame to carry the system of extraction tubes so that first they can all be agitated together, allowed to rest while the two phases separate, then tilted so that the upper phase is decanted and, finally, tipped to transfer this upper phase to the next tube. After this the cycle begins all over again.

The reservoir contains enough solvent to carry out any one complete operation. During each cycle a glass scoop automatically picks up and

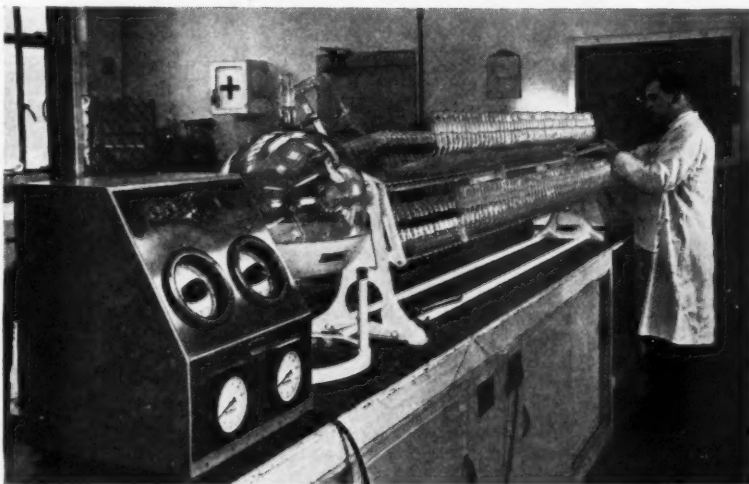
delivers to a measure a charge of solvent. The measure delivers 25 ml. to the first tube and returns surplus to the reservoir. The scoop and measure may be by-passed when recycling is required.

In considering the design of the machine it was decided that, since it is required to shake the carriage in a consistent manner for long periods, manual agitation was impracticable. The other movements take only a short part of the whole operation, however, and two types of drive were therefore adopted: automatic and semi-automatic, the latter saving more than 50% on the cost of the machine. There are, however, technical advantages in full automatic operation.

Agitation is provided by an 0.25-h.p. electric motor geared to 22 r.p.m. moving the carriage by means of a connecting rod. The carriage may also be moved manually when the drive motor is de-clutched.

The advantage of the automatic machine over the semi-automatic is that it can be left unattended for long periods, overnight for instance, and the time factor becomes less critical. Therefore much preliminary work in the determination of the ideal solvent system may be avoided, as less selective solvents can be employed and the required degree of separation achieved by recycling; also for the same reason there is greater freedom of choice of solvents and, for example, emulsification difficulties may be avoided.

CPE 576



Countercurrent liquid/liquid extraction apparatus.

Water treatment without use of heat or steam

Distilled quality water without use of heat or power is obtained from the new Mark V portable *Deminrolit* plant. Incorporating a dial-type conductivity tester and supplying up to 6 gal. of pure water hourly, the Mark V portable is particularly suitable for laboratory and small process work.

Basically, the plant consists of two columns of ion-exchange material. When raw water is passed through the first column containing *Zeo-Karb* cation-exchange material, the mineral salts in the raw water are converted to their corresponding acids. These acids are then passed down through the

C.P.E.'S MONTHLY REPORT AND READER SERVICE

second column containing *De-Acidite* ion-exchange material which absorbs the acid. The demineralised, or de-ionised, water which results from this process is of distilled quality.

The plant is easy to operate, thoroughly reliable, and the only running costs involved are the small quantities of acid and alkali required for regenerating the ion-exchange materials. **CPE 577**

Acetate fibre wadding

Known as B.A.F. wadding (bonded acetate fibre), a new wadding product is claimed to be capable of numerous applications in various industries. It is available in a wide range of densities, thicknesses, rigidities and widths, extending from dense, rigid, film-like materials to very light and open floss-like structures. Easy and pleasant to handle, it is highly resistant to rot, is not attacked by vermin and can be cut or stamped out to any required shape or size.

The wadding is particularly suitable as a resilient filling or padding between sheets of different materials (such as PVC, coated hardboard and certain types of fabric) and it can be sealed to plastic materials by modern R.F. welding techniques without the use of a separate bonding agent. It has a good recovery factor. Thermal conductivity is approximately 0.25 B.Th.U./sq.ft./hr. for a temperature gradient of 1°F./in. (this figure applies to wadding with a density of about 1½ lb./cu.ft.).

Another advantage of this material is that it is not brittle and has no tendency to disintegrate as a result of repeated shock and vibration.

CPE 578

Gooseneck booms

Gooseneck boom attachments, which have been produced for use with the manufacturer's range of electric fork-lift trucks, facilitate the handling of loads of irregular shape and size and can be used for lifting loads that require reaching over obstacles.

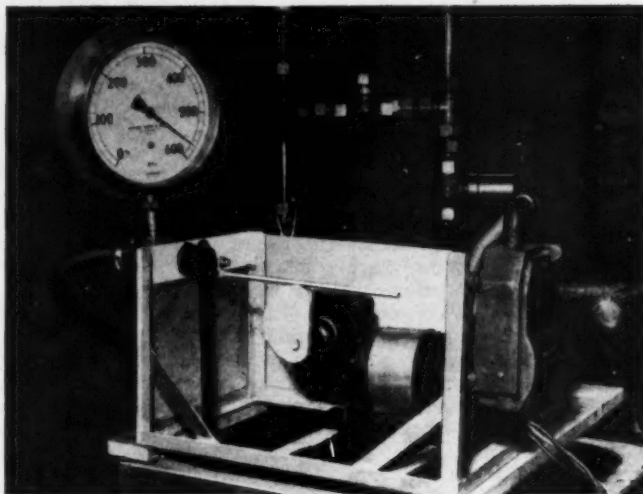
The boom is an all-welded steel unit that attaches to the fork carriage of the truck in the same manner as forks and is raised or lowered in the same manner. It can be quickly removed for fork substitution for normal fork truck operation. Standard booms are available in various lengths of outreach for each truck model. **CPE 579**

Ball valve withstands accelerated wear test

With the co-operation of the Wolverhampton Corporation Water Undertaking, a high-density polythene ball valve was recently subjected to an accelerated wear test at one of their pumping stations. The object of the test was to find the wearing capabilities of the polythene valve orifice.

The valve was actuated at a rate of

60 movements/min. for more than 29 hr. at the average pressure of 575 ft. head of water or 249 p.s.i. To simulate normal usage, the cam was so designed that the valve opened abruptly and closed relatively slowly. After more than 100,000 movements at this pressure, no wear or deterioration of any kind was observed. **CPE 580**



Ball valve on its electrically driven test rig.

Electronic recorders for vapour phase partition chromatography

Vapour-phase partition chromatography provides the equivalent of 2,000 theoretical plates in a matter of minutes. The vaporised sample (in one method of detection) affects the electrical resistance of a hot wire as it emerges from a chromatographic column. The changes in electrical voltage thus produced are measured by, and are automatically recorded on, the moving chart of a recorder.

The success of the process depends critically on the speed and accuracy of the measuring and recording equipment used. Fortunately this need had been anticipated by the development of electronic 'continuous balance' potentiometer recorders. These recorders are supplied as standard components by two principal manufacturers of vapour-phase partition chromatography equipment.

The changes in electrical resistance of the hot wire are measured by the instrument's 'continuous balance' potentiometer circuit. The measure-

ments are recorded as a series of peaks on the recorder chart. The position of the peaks on the trace affords the qualitative evidence for analysis. The height or area of the peaks provides the quantitative information required.

CPE 581

Self-contained lubricating system

The *Bowser* self-contained lubricating system, suitable for the lubrication of many types of machines, was recently demonstrated circulating oil through a number of *Bowser* flow indicating devices of varying types, including the *Teleflo* indicator, which is fitted with a micro-switch and conduit connection for operating a gong, howler or other alarm device. Used in a relay, it can also be made to shut off the main motor should liquid cease to flow. **CPE 582**

Coatings resist acids, alkalis

The *Semprene-Adcora* range of neoprene-based protective coatings are claimed to have good resistance to acids and alkalis, high tensile strength and elongation, resistance to heat (continuous exposures up to 250°F.) and to severe abrasion and atmospheric weathering.

In the plant of one of the largest U.K. chemical manufacturers, one pot maintenance grade of this coating has been used extensively on structural steelwork and process equipment, where previous systems had a life of between 4 and 20 weeks. It is claimed that the coating protects these surfaces as well now as it did when it was first applied in 1954.

In another example of the use of this coating, a 60-mil. neoprene internal coating of a duct carrying corrosive acids and traces of solvents was examined after eight years, during reconstruction of the plant, and was found to show no signs of deterioration. In a similar plant, a lead-coated exhaust blower exposed to sulphuric acid mist at temperatures as high as 180°F. was accelerated beyond the critical speed, so that the lead coating failed. A $\frac{1}{10}$ -in. thickness of neoprene has rendered this pump serviceable again, and was stated to be still in good condition after 14 months. Under similar conditions $\frac{1}{4}$ -in. steel plate would be corroded away in less than one month.

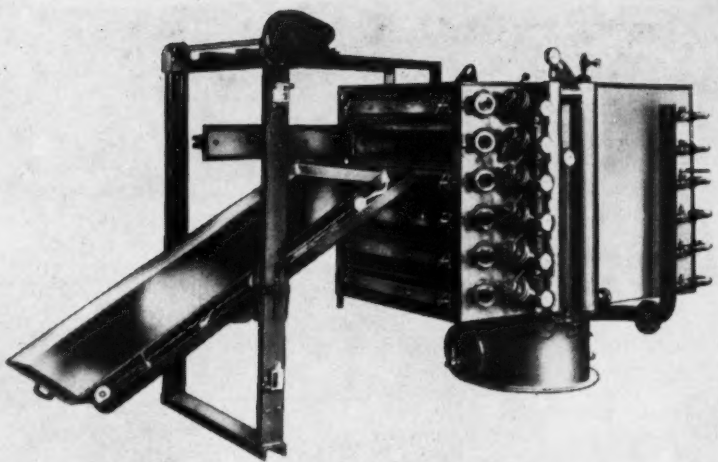
CPE 583



RUBBER DOORS FOR AIR-CONDITIONING

These special, steel-studded, rubber swing doors have been installed by a firm of air-conditioning engineers to control air movement in the *Billingham anhydrite mines of Imperial Chemical Industries Ltd.* Measuring 13 ft. 8 in. wide \times 13 ft. high, they are among the largest in the country.

CPE 584



Continuous-working, 6-compartment vacuum drier.

New vacuum shelf drier

The A.L.A. vacuum drier is capable of drying, in the absence of air and light, many pharmaceutical products, paint pigments, dyestuffs, food and vegetable extracts, yeast and yeast extracts, pepsin, pectin, photohormones, fine chemicals etc. This remarkable new machine has jacketed trays and the steam used in the jacket of the trays is sub-atmospheric steam which, of course, is at a pressure below the atmospheric pressure and it is therefore at a temperature below 100°C. When working at 30 mm. Hg absolute or approximately 29 in. of mercury, which is the normal working vacuum of the oven, the temperature in the trays can, of course, be as low as 25°C.

The cylindrical chamber under the drier is partly filled with water and partly filled with sub-atmospheric steam; live steam is allowed to enter into this chamber controlled by the thermostatic controller with a bulb in the water. The thermostatic controller thus controls the temperature of the steam leaving the chamber before it passes through the pipe to the valves at the back of the machine. From here the steam passes through the special stop valves at the back of each compartment, these valves being arranged so that no steam passes unless the tray is inserted in the oven. The steam passes into the jacket of the tray when the tray is in position and leaves the tray as either steam or condensate through a small nozzle. This nozzle discharges immediately into the opening of the appropriate

vacuum valve on the right-hand side of the drier from where steam and condensate together with the vapours from the drying material pass through a water-sprayed condenser to the vacuum pump. The top and the bottom of each compartment of the drier are also heated with steam coils to prevent condensation during the drying process.

The following are therefore the main advantages of the A.L.A. C-51 vacuum shelf drier:

- (1) Semi-continuous operation due to each tray having its own individual compartment, normally giving 30 mm. Hg absolute within 5 min. of closing the door.
- (2) Rapid even drying due to the steam jacketed trays. Normally giving 101/sq.m./hr. (or approximately 2 lb./sq.ft./hr.) evaporation with water only and an efficiency figure of between 1.1 and 1.3 lb. steam per lb. of moisture evaporated.
- (3) Low-temperature drying (down to 35°C. or 95°F. for practical purposes) with sub-atmospheric steam in the steam-jacketed trays.
- (4) Rapid inexpensive loading and unloading of the trays due to simple elevator. This also ensures minimum damage to the trays and obviates tray replacement, as they only have to be tilted to empty into a truck or bogie.

In addition to the units as mentioned

above with trays approximately 3 ft. \times 6 ft. giving 18 sq. ft. tray area and with either two, three, four, five or six trays per machine, a small pilot-plant machine with a single tray with an area of 3½ sq. ft. is available. This works on exactly the same principle as the machines described above.

CPE 585

New solvent-resistant silicone rubber

Fluorinated silicone rubber that retains its elasticity over a temperature span ranging from less than -60°C. to over 200°C. and displays a remarkable resistance to attack by aircraft fuels, hydraulic fluids and petroleum-based engine oils that limits the use of ordinary rubbers is now available in the U.K.

The new rubber, *Silastic LS-53*, was developed in the U.S. Combining the ease of fabrication of silicone rubbers with the solvent resistance of fluorocarbon chemicals, it is claimed as a major step towards achieving a low-swell, heat-stable rubber for use on jet planes—and ultimately in all those industries where rubber parts are exposed to oils, solvents and extreme temperatures.

CPE 586

Controlling pH dose rate

An electrically operated controller has been designed for use with standard pH measuring equipment for automatically regulating the flow of reagent to a process or effluent so as to maintain the pH within required limits.

The output from the pH meter is fed into the dose rate controller which carries adjustable high and low limit switches. If the measured pH is between these two preset limits no control action takes place. If the pH drops below the low pH limit one

output relay on the controller is energised; if the pH goes above the high pH limit another relay is energised. The energising of either of these two relays sets a two-stage timer into operation; the first-time stage energises a reversible electric motor in the motorised control valve either to increase or reduce the reagent flow.

The motor operates for a preset time (adjustable 0 to 30 sec.), depending on the process; at the end of this time the second-timer stage switches off the motor for another variable preset time (adjustable 0 to 5 min.). If at the end of this 'wait' period the pH has been restored to its required value, no further action takes place until another deviation outside the set limits occurs. If, however, the pH is still outside its limit, the cycle of events repeats until the correct pH conditions are restored.

The use of this enforced 'wait' period after each adjustment to the motorised valve allows for any time lags between the reagent addition and measuring points, and also allows time for the reaction change to take place as a result of the changed reagent flow rate. This system prevents 'hunting' of the control system.

CPE 589

POLYTHENE DRUM IS STEEL PROTECTED

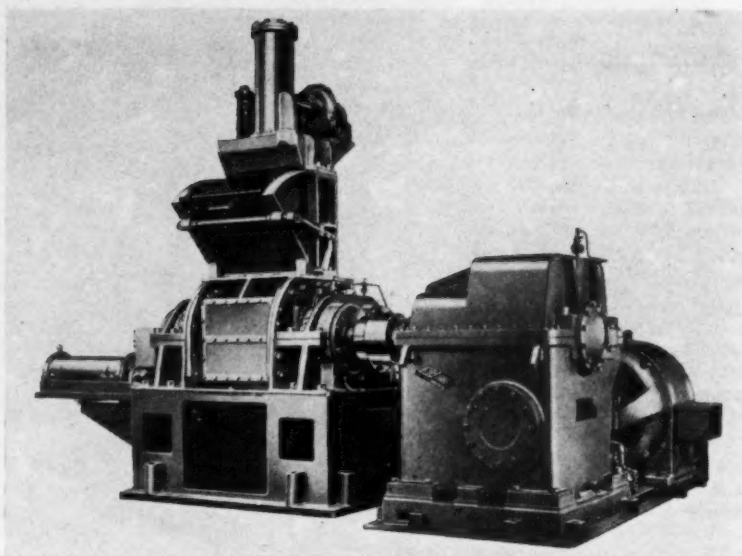
A polythene drum within a fitted steel outer casing for carrying chemical products is claimed to have the handling convenience of a container, outwardly a straightforward metal drum of low tare, which carries 10 gal. in less space than a 5-gal. demijohn and crate.

The *Waco* drum is really two containers: one of polythene to protect the product within its corrosion-resistant shell, and the other of steel to withstand robust handling. Whilst each has its special duty, they are built to function together as one integral unit.

The makers believe that the most effective polythene container can be produced only by moulding in one seamless unit, but, because it is easily abraded and penetrated, polythene demands the shield of the metal outer casing. Only the screw closures remain exposed for use, but their close design leaves them shrouded by the recesses in the drum head.

The two containers are carefully fitted together with shock pads where necessary, so that the polythene inner shell is under light compression when empty. This means that, even when the contents are surging violently, the walls are fully supported.

CPE 588



SPIRAL-FLOW MIXER

Under licence from the U.S. manufacturers, this spiral-flow intensive mixer for rubber and plastics is now being manufactured and marketed in Britain. It is especially suited for work on polythene and on butyl rubber where much higher than normal temperatures are required and temperatures up to 400°F. can be catered for when flood lubrication is employed.

Other advantages claimed for the mixer include fast mixing and dispersion, long effective life, low maintenance costs, extreme accessibility and a 20% less h.p. consumption due to the specially designed rotor.

CPE 587

New range of stainless-steel vessels

First details of a new range of standard production stainless-steel vessels have been announced. These are for all storage and mixing requirements and for heating and cooking.

Storage and mixing vessels are offered in a variety of types and in

vessels are of dull polished stainless steel and jackets are in mild steel. Alternatively, the jackets can also be offered in stainless steel.

The range of dished jacketed vessels from 25 to 200 gal. is in two types: one has a bolted-on jacket, whereas



Pressure vessels in stainless steel.

capacities ranging from 10 to 2,000 gal. Standard models are fabricated from 18/8/1 (EN 58B) stainless steel and are offered with alternative types of top edge stiffenings, legs, lids and outlets, depending on the size and purpose of vessel and gauge of material.

Based on their customers' most popular requirements, the makers produce hemispherical jacketed vessels ranging from 7 to 500 gal. Inner

the other has a welded jacket. From a construction point of view, they are similar to the hemispherical vessels.

The standard vessels are designed for a working pressure of 40 p.s.i. and are hydraulically tested to 80 p.s.i. Variations to suit individual needs and specific insurance requirements are undertaken. Turbo or anchor-type agitators, cooling coils, etc., can be provided. **CPE 590**

Automatic chemist

The *Titromatic Analyser* is a new analytical tool for large-scale chemical manufacture. Not only will the apparatus accurately perform the work of two or three chemists, but the visual record which it continuously presents enables variations in the plant stream to be detected instantly and corrective measures to be applied. It is believed to be the only apparatus of its type in existence.

The unit is connected to the main plant stream and at regular intervals a measured quantity of the solution being manufactured is fed to a reaction

vessel. After dilution with water, titration with a standard reagent begins and continues until the solution has been completely neutralised. The amount of reagent used is determined by an 'electric eye' which seeks and finds the level of the reagent and, in so doing, records the volume used on a recorder chart. In the meantime, the reaction vessel is emptying itself and the whole process starts again.

The *Titromatic Analyser* consists of two separate units. One of these is the chemical unit, which contains an array of glass vessels controlled by

automatically operated taps. The second is the electronic control unit, which determines the precise sequence of operations performed by the chemical unit.

The instrument has a wide range of application and the time cycle of a titration can be varied from once every 3 min. to once every $\frac{1}{2}$ hr. It is designed to operate day and night without attention other than a routine weekly inspection. **CPE 591**

Applying vitreous enamel

The installation of a Ransburg electrostatic spray unit for the application of vitreous enamels is being carried out at the works of a firm of vitreous enamelling engineers. This installation, which will be the first of its type in Europe, is being carried out in collaboration with the representatives for this process in the United Kingdom and Western Europe.

Development work on frits and the preparation of materials will take place to ensure the best possible results are obtained in the minimum time. Demonstration and service work will be carried out on potential users' products in this installation and the facilities available will enable work to be carried out not only on the application of the vitreous enamel but also the drying and fusing. Facilities will also be available for the preparation of frits, as desired. **CPE 592**

Electronic air filters

Electronic air filters have been developed which, it is claimed, collect dust below 10 micron down to 0.01 micron at very high efficiency. The principle of electronic air filtration is that all particles in the air, even those of sub-microscopic size, are electrically charged (positive) as they pass through the high-voltage ionising screen. These particles are then attracted and adhere to the collecting plates, which form the negative elements of an electrostatic field set up between a series of parallel plates, electrically charged alternately positive and negative. Periodically, depending on the dirt content of the air, the accumulation of dirt must be removed from the collecting cell. This is accomplished by merely opening a valve which sprays the cell with water and washes the dirt into the drain.

Trion electronic air filters are being

used in many applications, including the protection of instruments and precision-machined parts in manufacturing enterprises and laboratories and the elimination of product contamination in chemical, pharmaceutical and textile industries. **CPE 593**

Cock with automatic adjustment

During the construction of the Loch Sloy hydroelectric scheme, the problem arose of obtaining a cock incorporating features which would rule out the risk of damage under the exacting conditions met with on that occasion, but which could be produced at a reasonable cost. The cock, which was specially designed for the purpose, is now available to the engineering trade in general. It is constructed on the spring-loaded, inverted-plug principle. With this design, adjustment is automatic and it is not necessary to dismantle and readjust the plug should jamming take place.

The body of the cock is constructed of mild steel, and the plug, also of mild steel, is seated in a special liner. If, after extensive use, wear should take place, the plug can be reground in its seating, giving the cock a completely new lease of life. The detachable base plate makes access to the plug for this purpose a simple matter. This feature greatly reduces maintenance and replacement costs.

Each cock is tested to withstand a pressure of 150 p.s.i. **CPE 594**

High-duty combustion chamber

The growth of liquid fuel firing in recent years has necessitated research into the characteristics of atomisers or, as they are frequently termed, oil burners. A firm which has been prominent in this work has produced twin-fluid-type atomisers with close control of flame shape and of fuel droplet size.

The development of these atomisers has made possible the production of a new form of combustion chamber designed to approach a theoretically correct shape for high-intensity combustion.

The oil is finely broken up by the high-energy atomiser and spread evenly into a specially shaped combustion chamber. Secondary air is preheated



Cut-away view of standard pump unit fitted to the flanged endshield of an electric motor.

Centrifugal pumps incorporate mechanical seals

Pumps which have been specially designed for incorporating mechanical seals are the new *Seal* range, in which the arrangement of the mechanical seal is claimed to have the following advantages:

- (a) Complete cooling of the seal by the liquid pumped without resort to flushing pipes.
- (b) Large internal liquid area prevents settlement of suspended

or foreign matter around seal.

- (c) Replacement of seal is a simple matter; only the suction end cover and impeller need be removed.

These pump units, comprising volute, impeller, suction end cover and mechanical seal, are available with delivery connections in five sizes from $\frac{3}{4}$ to 1½ in. and all five sizes have the same shaft and flange dimensions for interchangeability of mounting. They can be bolted directly to engines or machines provided with suitable spigot and shaft extension, or to the flanged endshield of an electric motor. When fitted with ball-bearing housing and base the units become bare shaft centrifugal pumps for direct coupling or belt driving. **CPE 596**

Dry powder fire extinguisher

Specifically designed to combat fires long rated the most dangerous of all—those caused by inflammable liquids of all types, including alcohols and industrial solvents and electrical equipment—a new dry-powder fire extinguisher is claimed to be able to kill a fire in only a few seconds.

It is extremely simple to operate: by striking a knob, a cloud of fine

and injected through the combustion chamber walls, causing great turbulence and rapid intermixing of reaction products. These factors, together with the shape of the refractory walls which aids internal radiation, promote high rates of combustion. The heat release rate of these chambers is 1 million B.Th.U./hr./cu.ft. of combustion space.

The chamber is designed for complete control, either manual or automatic, of both air and fuel supply. This control can be varied to give combustion products from oxidising atmospheres to theoretical CO₂ content and, for certain duties, a relatively high percentage of CO can be obtained by operating below theoretical oil/air ratios. **CPE 595**

powder is shot out under pressure and smothers flames quickly and efficiently. In the hands of an experienced operator, the makers claim, the extinguisher will quell a petrol fire 9 sq.ft. in area.

The dry powder used consists of a number of chemicals, the principal being sodium bicarbonate. It is specially prepared, mixed, ground, sieved and dried, and pressure-sealed so that it will not cake, pack or coagulate. The oxidation inhibitors which are present in this powder halt the chain reaction of oxidation from one burning molecule to the next in a flame.

CPE 597



Differential-pressure unit.

Differential-pressure flowmeter

A British firm has announced the conclusion of a licence agreement with a U.S. company for the manufacture and sale of a differential-pressure flowmeter in Britain.

This instrument is based on a dry-type (no mercury) bellows-operated differential-pressure measuring unit, which may be used in conjunction with readily available recording, controlling and transmitting mechanisms from the British manufacturer's range to provide a complete range of flowmeter instruments.

The Model 700 differential-pressure

unit is described as combining the most modern engineering features, being designed to have ample power for sustained accurate measurement and fast-response speed. Wide-range temperature compensation is provided to maintain accuracy under the most adverse conditions, and the instrument embodies completely automatic over- and under-range protection.

CPE 598

Corrosion-resistant valve gives full flow passage

The first all-plastic Y-glove valve with full flow passage has been introduced by a U.S. company. Made of rigid polyvinyl chloride, the new PVC valve provides tight shut-off and flow control of alkalis, acids, inorganic salt solutions and other corrosive fluids used in the food, oil, gas, petrochemical, chemical, paper and allied industries.

The new valve, non-toxic as well as non-corroding, is claimed to assure fluid purity. A special bonnet and gland nut design provides an absolute leak-proof unit. Because of its sturdy construction, the valve will operate successfully at pressures up to 150 p.s.i. at 75°F.

An all-plastic assembly increases its durability. Each part is resistant to outside corrosion from plant fumes, drippings and other atmospheric hazards. Life of the valve's packing is prolonged through a tapered back seat on the stem which permits repacking under pressure. The same design also reduces pressure on stem packing when valve is opened completely.

CPE 600

Paper bags with polythene coats

Recent packaging developments have included the introduction of a range of polythene-coated paper bags to the food, pharmaceutical and chemical industries, under the trade name of *Telcothene*.

The outstanding characteristic of these bags is their strength and rigidity which makes them so suitable for unit packing of fluid and heavy powders. The bottom of the bags is sealed twice, thus militating against sifting, and they can be heat-sealed along the top.

Other valuable aspects are that the material is unaffected by water or inorganic chemicals in solution, and no deterioration is suffered by the materials packed. This is particularly important with solid and powdered chemicals, e.g. cement, plaster, waxes, caustic or acid-containing substances and plastic moulding powders.

CPE 601

Rubber lubricant

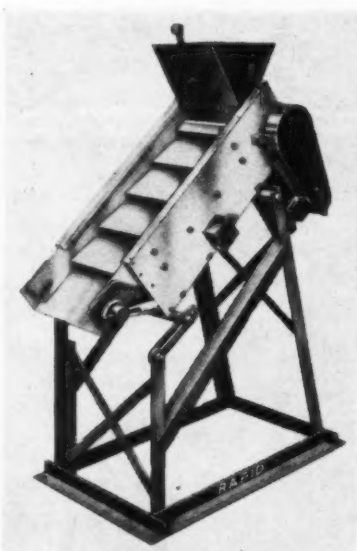
A new lubricant in the range of *Gredag* greases has certain unusual characteristics which make it especially suitable for use in conjunction with rubber. This bentone-based grease has a broad temperature range—from -55°C. to 200°C.—and is resistant to water, steam and most aqueous solutions. It also has a fairly good resistance to hydrocarbon oils and solvents and, it is further claimed, its consistency is not affected by rough handling or working.

CPE 602

Barrier cream reflects ultra-violet rays

Of a range of barrier creams for the protection of operatives in industry perhaps the most unusual is one which is designed to reflect ultra-violet rays and so counter the effects of such irritants as tar, pitch and their derivatives upon the skin.

Areas of the skin contaminated and exposed to light rays become photosensitised, bringing about a similar reaction to over-exposure to x-ray or ultra-violet light and ultimately causing exudating dermatitis and skin cancer. Experience during the past eighteen months has shown that this



POWDER TREATMENT

Rapid, type 'V,' vibratory chute-type separator for the treatment of fine powders requiring mechanical motion to precipitate the flow.

CPE 599

cream forms a very effective light barrier and the new cream has not only been a success against tar and pitch but also against the effects of arc welding. **CPE 603**



ELEVATING TRUCK WITH INTERCHANGEABLE ATTACHMENTS

A new model of the Jacacaddy elevating truck JT 1 has recently been placed on the market. The new model has been designated the JT 1D.

Its advantage is that its platform is interchangeable with the forks and jib attachment.

Its capacity is 672 lb. with a lifting height of 5 ft. 2 in. Its mast rollers have needle roller bearings, which greatly reduce frictional loss. **CPE 604**

PAPER SACKS FOR CHEMICALS

Evolved especially for the carriage of a granular nitrogenous fertiliser, a new type of multi-wall paper sack will be of interest to the chemical industry, especially for products for which protection from climatic conditions and chemical reactions is required of the package.

Careful transportation, joined with careful storing, was previously called for to prevent caking of the fertiliser from damp and to enable the product to retain its original properties over a period.

The new packing evolved is a five-ply paper sack, including one-ply polythene-lined and one-ply bitumen-lined. **CPE 605**

Temperature indication, recording and control

For the recording, control and indication of industrial temperatures, a new range of instruments is claimed to give potentiometric accuracy reproducible to approximately 0.2% full scale. They are available for any range span greater than 20°C. between -200°C. and 500°C. as single-point and as four-point recorders. An additional indicating scale approximately 11 in. diameter can also be fitted to the single-point model.

The ample servo-power available overcomes friction and provides the torque to operate electrical on/off con-

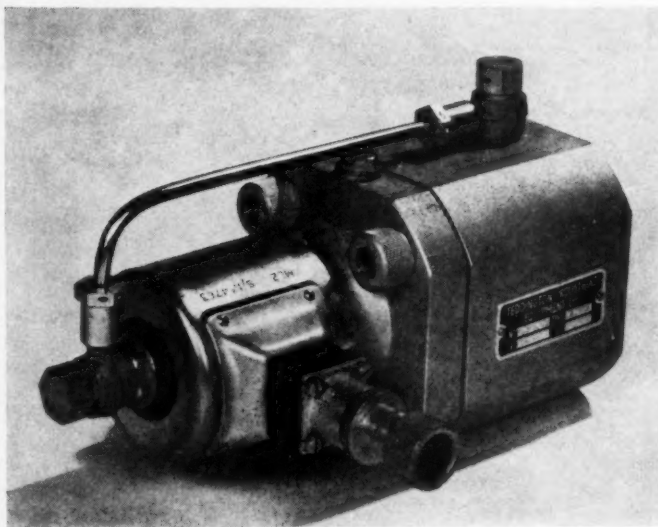
trollers or pneumatic controllers. All versions of the instrument are housed in a standardised case, the design of which is also independent of the range coverage.

The bridge circuit employed is fed with a.c. voltage and there is, therefore, no stabilised d.c. source required, nor is there any need for recalibration or standardisation when the instrument is in use. The simple, plug-in-type electronic chassis can easily be changed if required and, again, there is no need for recalibration. **CPE 606**

Controlling large flows at very high pressures

A two-way, piloted-piston type of valve for the control of chemically inert fluids or gases up to 1,650 p.s.i. can be made in sizes varying from $\frac{3}{4}$ to 2 in. bore and arranged either to open or to close when energised. It has two main assemblies: the solenoid-

bar the valve body is grooved to receive the tongued superstructure which is secured by four $\frac{1}{2}$ -in. Whitworth Allen screws. Non-corrodible materials have been used for all internal components and the piston assembly is constructed from stainless



New solenoid valve.

operated pilot valve and the piston-type main valve unit.

In view of the high pressures which the valve has to withstand, the materials used have been specially selected to ensure long, reliable service under the most arduous conditions. Precision-machined from mild-steel

steel. A synthetic-rubber valve disc ensures positive sealing.

The servo valve is constructed to aircraft instrument standards and has a continuously rated solenoid. Special attention has been given throughout to ensure 100% sealing at all joints. **CPE 607**

Technology Notebook

Research — Education — Discussion

Continental chemical engineering events

The European Congress of Chemical Engineering, 1958, which will take place from May 31 to June 8, 1958, in Frankfurt am Main in conjunction with the Achema Congress, 1958, will include the following congresses and meetings: the Achema 1958, 12th Exhibition and Congress of Chemical Engineering organised by Dechema; the 2nd Congress of the European Federation of Chemical Engineering, which will commence in Brussels on May 28 and 29 and will be continued at Frankfurt am Main from May 31 to June 8; the 2nd Congress of the European Federation of Corrosion; the special meeting and lectures of the Gesellschaft Deutscher Chemiker, and the annual meeting, 1958, of Dechema Deutsche Gesellschaft für chemisches Apparatewesen.

The invitation brochure is now ready. It is published in the English, French, German, Italian and Spanish languages and copies may be obtained free of charge from Dechema, Frankfurt am Main 7, Postfach.

Institution of Chemical Engineers examination

The 33rd (1957) Examination of the Institution of Chemical Engineers will be held in London and Manchester and at centres overseas between September 10 and 13, inclusive. Examination entrance forms, returnable not later than June 1, may be had on application to the General Secretary, Institution of Chemical Engineers, 16 Belgrave Square, London, S.W.1.

Linking science in school and industry

Preliminary grants to enable research projects to be undertaken in the science departments have been made by the Shell Petroleum Co. Ltd. to four well-known public schools as part of the drive to combat the shortage of scientists in Britain, which has been attributed to an insufficient number of the best young scientists being attracted to teaching as a profession. It has been thought that added attraction would be given to a teaching career if a research project could be undertaken as a part-time occupation within the circle of masters and boys specialising in science at individual schools.

Shell also contributed towards a course for some 250 science teachers held at University College, London, at the beginning of April and the programme included lectures on geology, geophysics, chemical engineering, chemistry and refining, new chemical products and agriculture, and automatic controls.

Careers in plastics

A broadsheet on 'Careers in Plastics' has recently been distributed by the Plastics Institute through the Central Youth Employment Executive of the Ministry of Labour and National Service to most schools in England, Scotland and Wales.

In addition, the Institute has published a pamphlet on its pupil apprenticeship scheme. Registration of pupil apprenticeships is undertaken and certificates are issued to such as have completed apprenticeship and technical training in accordance with the details of the scheme.

Biological consultants

The Institute of Biology publishes a 'Directory of Biological Consultants' which includes details of the fields covered by independent consultants in biology.

Copies can be obtained from the General Secretary, Institute of Biology, 41 Queen's Gate, London, S.W.7.

Radio-isotopes in scientific research

An international conference on radio-isotopes in scientific research

has been convened by Unesco and will be held in Paris from September 9 to 20. More than 1,000 scientists from all over the world are expected to attend. The conference will be strictly scientific in character. Its main purpose will be the exposition and discussion of new ideas or methods for the utilisation of radio-isotopes in scientific research. It will not be empowered to adopt resolutions or make recommendations.

International symposium on gas chromatography

The Analysis Instrumentation Committee of the Instrument Society of America has announced that it will hold its first three-day International Symposium on Gas Chromatography at the Kellogg Center for Continuing Education, in East Lansing, Michigan, from August 28 to 30.

The symposium is to be directed toward discussion of theoretical and practical advances in the field of gas chromatography as it applies to both laboratory analysis and industrial process control.

U.S. interest in inorganic chemistry

The newly-formed division of inorganic chemistry of the American Chemical Society offered its first programme of symposia, general papers, and social events at the society's national meeting in Miami, Florida, last month. Included were symposia on 'The Present Status of Inorganic Chemistry' and 'Unfamiliar Oxidation States of the Elements.'

GLYCERINE AIDS POLYMERISATION SPEED-UP

Research studies at the Polytechnic Institute of Brooklyn, New York, reported in *Manufacturing Chemist*, February 1957, have revealed that glycerine has a marked influence on the reaction rates of diffusion-controlled chemical reactions. Experiments show that glycerine increases the local viscosity of the reaction solution and hence influences the velocity of reaction. Other thickening agents (gelatin, polyvinyl alcohol, polyacrylamide etc.) increase only the macroscopic viscosity of the solution appreciably, and have no effect on the reaction rate.

This unique effect of glycerine has been studied quantitatively in four reactions. Results show that increasing the glycerine content of the media markedly alters the rate of polymerisation of vinyl compounds, the rate of clotting of blood, the fluorescence of diphenyl methane dyes and the rate of photo-bleaching of dye. Of these discoveries, the effect on vinyl polymerisation appears to be of most practical significance since both the rate of reactions and the molecular weight of the resultant polymer are enormously increased by the mere introduction of glycerine.

Chemical Engineering and the Clean Air Problem

Enforcement of the Clean Air Act and the extended provisions of the Alkali Act are likely to pose serious technical problems and the recent conference on clean air which was organised by the Institution of Mechanical Engineers, and officially supported by 19 other professional societies, dealt almost as much with chemical and chemical engineering problems as with purely mechanical engineering problems. Some of these are mentioned in the following summary.

SPEAKING generally, the nature of the problem to be solved in the next decade or two is suppression of air pollution due to smoke, grit and dust and, as far as possible, due to chemical gases and mists and other pollutants.

Four major lines of attack on the air-pollution problem, all of which should be followed or fully explored, to enable rapid advance to be made, were suggested by Sir Ewart Smith in his opening address. They were: (1) improvements to the method of operating a process to reduce the creation of noxious effluents; (2) installation of new (or improvement of existing) subsidiary equipment for removing pollutants at the end of a process; (3) changes in the process and (4) the use of taller chimneys.

Dr. G. E. Foxwell, who summed up the conference, drew attention to the relationship between pollution due to fine dust and pollution due to sulphur dioxide. Discussion of flue gas washing at the conference showed that little real progress is being made and that there is no prospect of being able seriously to attack the problem of sulphur dioxide pollution due to power station emissions, although, as shown by another speaker, Mr. W. A. Damon, in his paper on the chemical industry, progress is being made where flue gases contain at least 0.5% of sulphur dioxide. The difficulty is that the national average for sulphur dioxide content of flue gases is only 0.1%. Dr. Foxwell pointed out that, if more attention were paid to ways and means of effectively preventing emission of fine dust, *i.e.* that of size ranging from, say, 20 microns down to $\frac{1}{2}$ micron or less, the sulphur dioxide problem might more or less solve itself.

He based this suggestion on medical evidence, which showed that sulphur dioxide is adsorbed on to fine particles of dust and inhaled deeply into the most sensitive tissues of the lungs where gas exchange occurs. Getting rid of fine dust would at the same time,

according to this suggestion, help to reduce the sulphur dioxide hazard.

Dealing with waste gases

Mr. Damon's paper dealt, among other things, with noxious gases, including hydrogen sulphide, oxides of nitrogen and fluorine. Amongst the many possible ways of dealing with waste gases containing hydrogen sulphide referred to by the author, mention might be made of that used at many viscose silk works, *i.e.* absorption in caustic soda to produce sodium sulphide. Another method is absorption by passage through hydrated iron oxide, which can be regenerated to produce spent oxide containing up to 50% sulphur.

Where the amount of hydrogen sulphide is sufficient to justify capital outlay, as at a large petroleum refinery, it becomes practicable to strip it out by a solvent, *e.g.* diethanolamine, and regenerate it in concentrated form for treatment in a Claus kiln, with production of pure elemental sulphur. In other cases, *e.g.* at sulphate of ammonia plants associated with a sulphuric acid plant, the waste gases containing hydrogen sulphide may be burnt to sulphur dioxide for conversion to sulphuric acid.

In the case of oxides of nitrogen, nitrogen peroxide may be recovered in the form of nitric acid by water washing, but for every 3 mol. of nitrogen peroxide thus absorbed there is evolution of 1 mol. of nitric oxide, which must be re-oxidised to nitrogen peroxide to complete the cycle. Total absorption is thus not possible; and, as oxidation of NO to NO₂ slows down more and more as the concentration of NO is reduced, a point is reached beyond which the plant required would be too large to be practicable. However, gases from ammonia oxidation plants can be denuded of their oxides of nitrogen to an extent of about 98%.

Similarly, gases from dissolution of metals in nitric acid can be dealt with and, in this case, the efficiency of the

process can be increased by adding oxygen. It is also possible to destroy small quantities of oxides of nitrogen by admixture with coal gas and burning.

Fluorine

In the case of fluorine, air contamination has aroused a certain amount of uneasiness. However, hydrogen fluoride can be scrubbed out of waste gases and experiments have been made in this direction. The problem here is due to the large volume of gas to be treated. Furthermore, as in the case of washing power-station flue gases, the advantages gained may be considerably offset by the cooling action of the waste gas and increased local deposition of the very material which it is desired to get rid of.

In the production of superphosphate, up to half the fluorine content of the raw rock is evolved as silicon tetrafluoride. Fans draught the mixers and dens into a series of void towers, where the gases are washed by liberal spraying with water. The tetrafluoride is decomposed with release of silica and hydrofluosilicic acid, which is removed in the waste water. With care and provision of adequate tower space, the removal of over 99% of the acid constituents is possible.

Dusty or misty gases

For efficient separation of solid or liquid particulates from waste gases prior to their discharge, Mr. Damon points out, removal is best carried out by electrical precipitation, cyclones, washing, settlement or a combination of these methods. Many of the papers at the conference dealt with various aspects of this problem.

In the paper on 'Dust Problems of the Iron and Steel Industry' Prof. M. W. Thring and Prof. R. J. Sarjant described methods of dealing (or attempting to deal) with iron oxide fume in a range of furnaces by means of Pease Anthony scrubbers, electrostatic precipitators, continuous slag wool filters, dry cyclones, wet tower-gas washers and wet power-driven centrifugal separators etc.

Grit and dust classification

It was mainly during discussion of the papers on 'Mechanical Grit and Dust Collectors' and on 'Present Performance and Scope for Improvement in Power-Station Electrostatic Precipitators,' however, and in the

Estimating Data

Building Costs in the Chemical Process Industries

THIS month we present some figures relating to building costs, the percentages in the accompanying table having been averaged from the Board of Trade census of production in 1948 and 1949. The cost of buildings is expressed as percentages of the cost of the plant and machinery which they house and support. The advantage

of knowing these costs percentage-wise are:

- (1) Allowing the assumption, which is not quite true, that plant costs and building costs rise at the same rate with time, we have an estimating figure which is free of escalation effects.
- (2) The chemical engineer who

estimates the plant cost has an easily applied figure for calculating building costs.

The industrial groups are those used in their statistics by the Board of Trade.

The recommended procedure is to use the figure for the industrial group with which one is concerned. If one cannot be certain about this, use the average figure of 31.

(More estimating data from the Census of Production will be published next month.)

Industrial group	Buildings cost as % of plant and machinery cost
Coke ovens and by-products	10
Dyes and dyestuffs	32
Fertiliser, disinfectants, insecticides and allied trades ...	46
Coal-tar products	29
Chemicals (general)	24
Drugs and pharmaceutical preparations	53
Toilet preparations and perfumery	25
Explosives and fireworks	26
Paint and varnish	58
Soap, candles and glycerine	18
Polishes	44
Ink	28
Matches	37
Mineral oil refining	20
Seed crushing and oil refining	23
Glue, gum, paste and allied trades	19
Average for chemical and allied trades	31

C.P.E. COST INDICES—LATEST FIGURES

The figure for February 1957 in our plant construction cost index is **169.3** (June 1949 = 100).

Last month we published the CPE chemical plant equipment cost index from January 1954 to January 1957. To this may now be added the figure for February 1957, which is **157.1** (June 1949 = 100).

final summing-up of the conference by Dr. Foxwell, that interesting chemical engineering problems emerged. The authors of the first paper referred to, J. C. Johnson and G. C. Goodwin, and those of the second paper, J. S. Forrest and H. J. Lowe, were mainly concerned with dust and grit extraction plant for power station and industrial boiler chimneys, but the equipment is, of course, of general interest to the chemical and process industries.

The main points which emerged from these papers were as follows. In view of the fact that there is no official guidance in the Clean Air Act or elsewhere regarding the extent to which grit and dust should be removed from gases leaving chemical and process plants, nor of the lower limit of size which can be tolerated, it may well be that a very large number of extra processes will in future come under the Alkali Inspector and, as Dr. Foxwell put it when referring to 'those who showed signs of alarm

and despondency,' he will 'make the punishment fit the crime.'

If grit and dust is classified into (a) gritty dust, effectively larger than 76 microns, (b) normal dust, ranging from 76 microns to 10 or 20 microns, according to the efficiency of mechanical collecting plant employed and (c) fine dust, ranging from 10 or 20 microns to a fraction of 1 micron, the discussion suggested that in some cases particles 100 microns in size do escape from mechanical collecting plant in spite of claims to the contrary, and that large numbers of dust collectors throughout industry are either out of operation due to lack of maintenance, or working badly due to overloading.

Furthermore, it was quite clear that, where mechanical dust-collecting plant is employed, in many cases dangerous emissions of fine dust are unabated, and that in many cases installation of electrostatic precipitators only partly solves this problem. For example,

with an overall collecting efficiency of say, 90% to as high as 98%, the collecting efficiency for fine dust particles may only be 16%.

From the discussion of dust-collector design it emerged that stricter standards are to be enforced and that those who do develop improved dust-collecting plant will find that they have more customers than they can easily supply. Undoubtedly a serious attack upon outstanding chemical engineering design and performance problems in the fine dust range is urgently required.

Chemical polishing solutions.

Two new data sheets on *Phosbrite* 150 and 159 polishing solutions have been issued by Albright & Wilson Ltd., 49 Park Lane, London, W.1. Each of these solutions is suitable for all grades of aluminium, from commercial purity to super purity.

New Books

Petroleum technology

This work* has been developed from a book, which was written in Dutch by the same authors during the last war, mainly for the benefit of students at technical schools and of others wishing to acquire a general knowledge of petroleum technology without having to delve into a mass of specialised detail. As such, it provides a useful, concise introduction to the whole field of petroleum production and refining, describing the exploration and drilling for petroleum, the composition of the various kinds of crude oil, the manufacture of the numerous derivatives that are made from it and the properties that these products should possess. Such subjects as storage, measurement, distribution etc. are not considered. The book is illustrated with photographs and numerous line drawings.

**Petroleum and its Products*, by J. H. van der Have and C. G. Verver. Sir Isaac Pitman & Sons Ltd., London, 1957. Pp. 421, including index. Illus. 50s. net.

Hydrogen ions

Intended for the technical chemist and also for students, the first volume of the revised and up-to-date fourth edition* of this work is the third volume in a series of monographs on applied chemistry founded by the late E. Howard Tripp, PH.D. The book deals mainly with the theory and methods of determining hydrogen-ion concentration or activity and each of the 21 chapters is fully illustrated with tables and graphs.

This edition provides a full discussion of the extensive work on which the standardisation of the pH scale is based, arising out of the standardisation specification of the British Standards Institution in 1950. In the course of it numerous buffer solutions are described which are, in effect, based on the B.S.I. Standard and may therefore be used in pH measurements involving the hydrogen, glass, quinhydrone or other suitable electrodes.

**Hydrogen Ions*, by Hubert T. S. Britton. Fourth edition. Chapman & Hall Ltd., London, 1956. Pp. 476, inc. index. 70s. net.

Nuclear research

This volume* is one of six providing a useful reference for the scientist and engineer working in the nuclear energy field. It has been prepared by the

U.S. Atomic Energy Commission and gives detailed descriptions of six representative types of United States' research reactors. The six reactors discussed include three types of light-water-moderated reactors (solution type, pool type, and materials-testing reactor), one hydrocarbon-moderated, one heavy-water-moderated, and one graphite-moderated reactor. This selection, it is pointed out, is in line with the trend to all-purpose designs that furnish a maximum neutron flux and maximum experimental versatility for a given budget.

For each of the various types of reactor, the book deals with general design features, core design and fuel handling, cooling system (where appli-

BOOKSHOP SERVICE

All books reviewed in *CHEMICAL & PROCESS ENGINEERING* and all other scientific or technical books may be obtained from:

Technical Books,
308 Euston Road,
London, N.W.1.
Telephone: Euston 5911.

Prompt attention is given to all orders.

cable), control and instrumentation, shielding, experimental facilities, and operating characteristics. Numerous selected design drawings are included.

**Research Reactors*, prepared by the U.S. Atomic Energy Commission. McGraw-Hill Publishing Co. Ltd., London, 1955. Pp. 460. 49s.

Physical metallurgy

These two books* have been prepared together and are intended to assist the professional metallurgist in developing a basic understanding of metal behaviour. In his preface to the first the author states that this book is an attempt to develop and to present a science of metal behaviour as an integrated, consistent, and satisfying chain of reasoning, extending from the familiar principles of physics and chemistry to the observed behaviour of the industrial metals and their alloys. The second book begins where the first one leaves off and considers in a systematic manner the effects of composition and of heat treatment upon the structures and properties of metals and their alloys.

**Principles of Physical Metallurgy* and *Alloys Series in Physical Metallurgy*, by M. C. Smith. Harper & Bros., New York, 1956. Pp. 417 and 337, inc. index. 50s. net each.

Extensive new chemical engineering research facilities

The establishment of extensive new laboratories for the research and development of chemical and chemical engineering plant is now being planned by the Balfour Group of companies. The parent company, Henry Balfour & Co. Ltd., has decided to purchase a large site of approximately 25 acres close to their existing works at Leven, Fife, for this purpose. It is anticipated that the future industrial expansion of the seven companies comprising the Balfour Group will take place on this site.

A substantial staff of qualified chemists and chemical engineers, already operating in existing laboratories, will be engaged in research, and this staff will be augmented to take care of the greater range of work which it is anticipated will be undertaken.

The main bay will contain a comprehensive range of pilot plant and equipment for the processing of materials from which reliable design

data can be obtained in the fields of evaporation, drying, distillation, extraction, absorption, size reduction, heat transfer, fluid flow, dust recovery, filtration, carbonisation, electrolysis, dispersion, mixing, agitation and general chemical reactions. Special attention will be paid to materials of construction, and separate laboratories for corrosion, mechanical testing, chemical analysis, physical chemistry, metallurgy and radiographic examination are being installed.

In addition to 35,000 sq. ft. of laboratory and pilot-plant space equipped with overhead cranes and all services, there will be conference rooms, library facilities, drawing office and design departments and a separate building for inflammable solvents, noxious gases and ionising radiations.

The Balfour Group specialise in the initial design, development and manufacture of chemical process plant, and new developments reflecting the latest advances in physical and chemical

Trans-Iranian Pipeline

About 1 million tons of petroleum products will flow from the great Iranian oil centre at Abadan to Teheran, the capital, following the completion of a 700-mile pipeline running from the coast to the interior of the country. The pipeline, which will be operated by the National Iranian Oil Co., will relieve the overburdened rail and road routes upon which Teheran has been dependent for its supplies of petroleum, kerosene, and gas oil.

Responsibility for the major part of this important project was entrusted to a British company, Costain-John Brown Ltd., who were awarded a £6½-million contract by the N.I.O.C. for the design and construction of the section of the line between Ahwaz and Azna—a stretch of about 300 miles. At a recent gathering in London, Costain-John Brown Ltd. showed a film which gives striking evidence of the formidable task involved. The pipeline's route crossed some of the most rugged terrain in the world and



A general view of No. 5 pumping station at Pali-Baba-Hassan showing the main storage tanks. Part of the Costain-John Brown pipeline in Iran.

the work had to be carried out in temperatures ranging from 130° in the shade to below freezing point.

The contract, which involved the

construction of four pumping stations, covered a period of two years, yet so successful were the methods employed that the work was finished in 20 months.

science are being pursued, particularly in the fields of ultra-high vacuum for molecular distillation, the construction of high-temperature and pressure equipment for conditions approaching the limits of physical properties, and the use of ultra-high frequencies to increase the rates of chemical reaction.

In conjunction with this development programme, a scheme has been launched for the training of technical

personnel in chemical engineering, mechanical engineering and chemical spheres.

The Balfour Group includes Henry Balfour & Co. Ltd., George Scott & Son (London) Ltd., Ernest Scott & Co. Ltd., Enamelled Metal Products Corporation (1933) Ltd., Balfour Lecoq Ltd., Dominion, Scott, Barron Ltd., Canada, and George Scott (Australia) Pty. Ltd.

Fast-slow Reactor at Harwell

Harwell now has a fast-slow reactor, a simple modification having resulted in interesting changes to the characteristics of the fast reactor *Zephyr*.

Graphite has been substituted for the uranium bars that originally formed the outer reflector. The thin inner reflector of uranium still surrounds the plutonium core.

In its new form the reactor diverged with a critical mass of plutonium very close to that in the uranium reflected system. Because the neutrons reflected back into the inner reflector have been slowed down, *Zephyr* now shows some of the characteristics of a thermal reactor. For instance, experiments have shown that the chain reaction can

now be controlled, as in a thermal reactor, by putting an absorber of slow neutrons such as cadmium into the graphite.

It is too early to predict the applicability of this 'mixed' system to powder breeder reactors such as that at present under construction at Dounreay.

Zephyr, became critical for the first time on February 5, 1954, and its name is derived from the initials of its title—zero energy fast reactor. In August 1955 it was announced that in this pile Harwell scientists had succeeded in creating two atoms of new plutonium for each atom of plutonium consumed.

Moving Gas Cylinders

The many cylinders of nitrogen used in the research department of I.C.I.'s Nobel division at Ardeer had formerly to be manhandled and transported on barrows. Since each cylinder weighs 1½ cwt., this process involved the possibility of muscular strain and meant awkwardness of manoeuvre. Now, however, with the introduction of the *Ardeer* cylinder transporter, designed by Mr. R. J. McD. Maxwell, chief physiotherapist at Ardeer, the problem of moving gas cylinders has been considerably eased.

The new instrument bears some resemblance to the popular golfing caddie-car. The cylinder is first loaded on to a nest, which is firmly attached and gives the cylinder a base to stand upright. The cylinder with the nest attached is manoeuvred by a simple drill to a position in which the transporter part can be moved forward and locked. The cylinder is then lowered into the transporting position, and the whole is easily wheeled.

It is pointed out that perhaps the greatest advantage comes when the problem of stacking arises. The transporter can be wheeled straight to the point of use and the cylinder in its nest placed in the expected position.

★ Personal Paragraphs ★

★ Johnson, Matthey & Co. Ltd. have announced the election of **Mr. G. C. H. Matthey** as chairman, following the recent death of **Mr. H. W. P. Matthey**. Mr. G. C. H. Matthey was appointed a joint managing director of the company in 1913 and served in this capacity for 35 years.

★ **Mr. B. Trehearne**, formerly development officer at the British Welding Research Association, has been appointed by Langley Alloys Ltd. to develop a welding section for corrosion-resistant copper and nickel base alloys. The development work will embrace the welding of aluminium bronzes, *Hastelloys*, *Monel* etc.

★ The economic, technical and goodwill mission to the Canadian petroleum and allied industries which arrives in Canada this month from the United Kingdom is being led by **Mr. J. M. Storey**, managing director of Dewrance & Co. Ltd. The main object of the mission is to examine all means of promoting and increasing sales of British manufactured engineering products to the Canadian petroleum and allied industries.

★ **Mr. F. H. Roberts** has been appointed a director and chief engineer of John Thompson (Australia) Pty Ltd., a member company of the John Thompson Group. He has played an important part in the development of power station plant using Victorian brown coal and New South Wales black coal and briquettes.

★ **Dr. D. C. Freshwater** has been appointed head of the new Department of Chemical Engineering at Loughborough College and takes up his new post at the beginning of this month. He was formerly a lecturer in chemical engineering at Birmingham University. He is a member of the education committee and board of examiners of the Institution of Chemical Engineers, and a member of the Chemical Engineering Group Committee of the Society of Chemical Industry.

★ Sales manager and director of Peter Brotherhood Ltd., **Mr. Ernest Markham**, has been elected president of the Whitworth Society, one of the most exclusive engineering societies in the country. At 62, he is one of the youngest men to hold this office. A Whitworth Exhibitioner, Mr. Markham served as a naval engineer officer in the 1914-18 war. He joined Peter Brotherhood's as assistant manager in 1919 and established a new refrigera-



Dr. D. C. Freshwater

tion machinery department. He was appointed sales manager in 1931 and has been a director for a number of years.

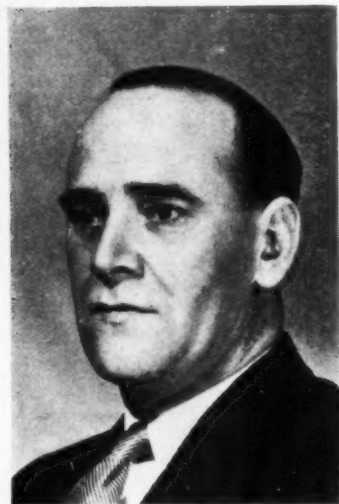
★ **Mr. W. R. Owen** was recently promoted from manager of the Sheffield branch office of Honeywell-Brown Ltd. to manager of the North East region. He will now be responsible for making comprehensive instrumentation facilities accessible to every corner of industry in this area, by opening and staffing additional offices and by forwarding recommendations for extensions to the range of equipment available.



Mr. J. M. Storey

★ **Sir Harold Hartley**, G.C.V.O., F.R.S., is to be president of the Society of Instrument Technology in succession to **Mr. A. J. Young**, who, having held this office for the past three years, retires after the annual general meeting on May 28.

★ In connection with plans for an extensive programme of fundamental research in various branches of chem-



Mr. W. R. Owen

istry, Pfizer Ltd. of Folkestone, Kent, announce the appointment of **Dr. R. J. Boscott**, as head of chemical research. The new post is a major appointment. Dr. Boscott, who is 41 years of age, will take up his duties with Pfizer Ltd. in the near future. Since 1948 he has been Lecturer in Endocrine Chemistry at the Medical School, Birmingham University.

★ **Mr. H. Smith**, who has been joint managing director of the Dyestuffs Division of Imperial Chemical Industries Ltd. since 1955, has been appointed joint managing director of the General Chemicals Division. **Dr. C. R. Mavin**, previously Dyestuffs Division production director, has succeeded Mr. Smith as joint managing director of that division. **Mr. R. S. Wright**, previously production director of the Pharmaceuticals Division, has been appointed to the Dyestuffs Division Board as production director. **Mr. J. Grange Moore**, who has been a production manager of the Metals Division since 1955, has been appointed works and personnel director of the Wilton Council.

SOUTH AFRICA

New £2-million fertiliser factory

The Fisons' organisation in South Africa expect to spend some £2 million on a new fertiliser factory which will be situated in the Orange Free State close to the new oil-from-coal plant. The Sasolburg factory will be designed for an annual capacity of 200,000 tons of superphosphate, together with a quantity of compound granular fertiliser to meet normal demand in the Orange Free State and the Transvaal for such fertilisers.

The Sasolburg site was chosen not only because it was near the oil-from-coal plant but also because its central position permits ready delivery over a wide area in the Orange Free State and Transvaal. It is hoped to have this factory in full production in 1959. Although it may eventually be possible to use phosphate rock from Phalaborwa in the eastern Transvaal in this new factory, the plan is, initially at least, to import phosphate rock from Morocco for processing.

NORWAY

Large titanium deposits

The titanium ore deposits near Jössing Fjord in western Norway have been found to be even larger than at first believed. It is now estimated that there are 350 million tons in the area, of which 166 million tons have already been mapped. Titania Ltd., the company responsible for the discovery, plans to invest 75 million kroner in building new works and extending its operations. The company has also allocated 7 million kroner to experiments aimed at a more effective exploitation of the ore.

VENEZUELA

Petrochemical Institute

The Minister of Mines stated recently that the first phase of the Venezuelan Petrochemical Institute project, costing Bs. 225 million, was 60% complete.

Initial production is at an annual rate of 10,000 metric tons of chlorine, 11,200 tons of caustic soda, and an increasing quantity of fertiliser, some of which is already on sale and which it is hoped will eventually reach a rate of 150,000 tons p.a. The second phase, costing Bs. 250 million, and starting late in 1957, is to consist of the production of explosives, herbi-

cides, fungicides and natural gasoline; also included in this phase is the development of the national gas pipeline network for which the Institute is now responsible; this is to include the purchase of the Venezuelan Atlantic Refining Corporation's system.

It is stated that the third phase, to cost Bs. 500 million, and scheduled for 1958-60, is to include the production of synthetic rubber, plastics, lacquer and refined oils. (The Institute is eventually to have its own oil refinery.) Thus, according to present plans, the total investment should have reached Bs. 1,000 million when completed in 1960.

PAKISTAN

Fertiliser factories

In a speech in the National Assembly on the need for increased food production the Minister of Finance referred to the government's plan to set up a fertiliser factory in each wing of Pakistan. He said that the capacity of each of these factories will be 200,000 tons p.a.; they will produce urea and ammonium nitrate.

GREAT BRITAIN

Cyclohexylamine

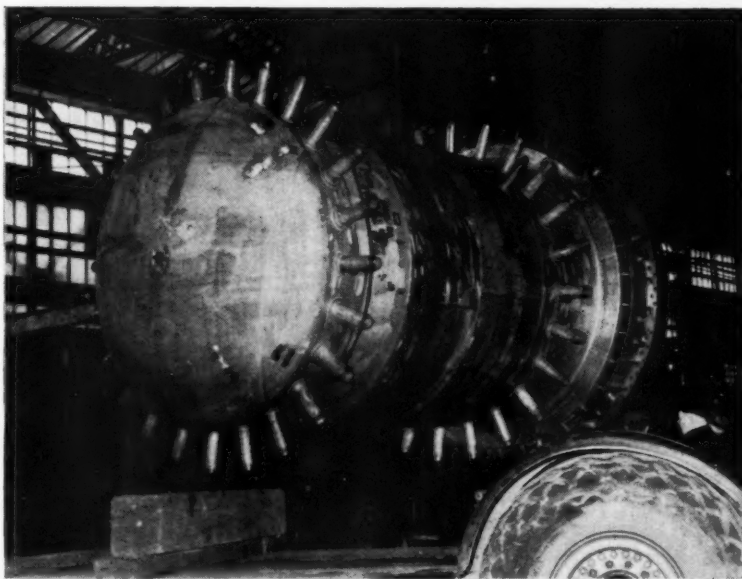
A plant for the manufacture of cyclohexylamine (hexahydroaniline) has come on stream at the Newport factory of Monsanto Chemicals Ltd. and is now in full production.

Whilst part of the plant's output will be used by Monsanto in the manufacture of rubber accelerators, an appreciable volume will be marketed as a chemical intermediate used in the production of paints, petrol, lubricating and cutting oils, resins and wax-emulsion polishes, and the processing of textiles.

Uranium supplies

Representatives of the federal and territorial governments of the Federation of Rhodesia and Nyasaland and of the United Kingdom Atomic Energy Authority have, during the last year, discussed measures to encourage prospecting for uranium within the Federation and the arrangements for the development of uranium deposits if they are found.

The U.K.A.E.A. are ready to buy annually in the Federation chemical concentrates containing 500 tons of uranium oxide. Contracts would be offered covering a 10-year period from



FAST-BREEDER REACTOR VESSEL FOR DOUNREAY

This complicated stainless-steel vessel was recently despatched from John Thompson Ltd., at Wolverhampton, by road and sea to Dounreay, Scotland, to serve as a container for the U.K.A.E.A.'s fast-breeder reactor. It has taken 18 months to build and, while its overall dimensions are some 20 ft. x 14 ft., the complex control rod tubes, instrument pipes, rotating shields and inner components of the vessel were positioned and welded to thousandths of an inch. More than 3,500 x-ray negatives were taken to ensure that every welded joint is absolutely leak-proof.

the coming into production of a mine, providing that the end date of the period does not extend beyond 1972.

The Authority have also offered to the Federation, free of charge, geological and technical assistance in the search for uranium and are prepared, in suitable cases, to carry out prospecting operations themselves.

The federal and territorial governments have welcomed the Authority's proposals and have in return agreed that the Authority shall have a first option on any supplies of uranium which are available for export.

Since this was made known, it was announced in a joint communiqué issued by Britain's Prime Minister and Mr. St. Laurent, the Canadian Prime Minister, at the end of their two-day talks in Bermuda, that Britain has agreed to buy uranium worth \$115 million from Canada during the next five years for its expanded nuclear power programme.

BRAZIL

Synthetic rubber plans

The technical studies concerning the plan to install a synthetic rubber factory in the State of Sao Paulo are now reported to be nearing completion. It is hoped that the establishment of this factory will eventually obviate the need to import rubber to complement Brazilian production of natural rubber. Imports over the last few years of Malayan and Indonesian rubber have been of the order of 10,000 tons p.a.

Petrochemical industry

The National Petroleum Council have issued a resolution regarding the petrochemical industry which makes it clear that private enterprise will be allowed free scope in this field. The national oil monopoly, Petrobras, will, however, be entitled to intervene if any one private company seems to be monopolising part of the industry or if private enterprise neglects any important petrochemical product.

ISRAEL

Chemical industry proposals

The newly established Technological Advisory Board to the Israeli Ministry of Development has suggested the establishment of a £12-million phosphate rock concentration plant.

The board has suggested that the new plant should consist of a full-size furnace with a capacity of 60,000 tons. To be situated near the phosphate rock quarries at Oron, the plant would be expected to reduce current phosphate production costs by 20 to 30%.

With regard to potash, the board suggested that, for the time being, efforts should be confined to improving the efficiency of present operations at the Sodom potash plant rather than engage in new expansion projects.

The board further recommended that research into chemical precipitation of potassium be given high priority in view of the promising nature of experimental work done in this field and the possibility of replac-

ing the existing process by a more economical one. Serious investigation of the possibilities of upgrading low-priced potassium chloride to potassium products of high value was also suggested.

Calcium carbide production

A plant for the production of calcium carbide is under construction at Petan Tiqvah, near Tel Aviv. Designed to have a production capacity of 4,000 tons p.a., it will more than meet local requirements of 3,000 tons p.a., and an export surplus is envisaged. At present, calcium carbide has to be imported at a cost of some \$400,000 p.a. mainly from Norway, Finland and Yugoslavia.

The new plant will receive its raw materials in part from local sources and partly from abroad. Lime deposits of high quality have been found near the factory site.

It is hoped to finish construction of the plant this year and to start manufacture before the end of 1957. It will form part of a larger complex of plastics plants, starting from the raw materials and producing a wide range of finished products.

NETHERLANDS

State Mines' coke production

The coke factories of the Netherlands State Mines produced a record 2,934,000 tons of coke in 1956. The sale of coke gas showed a 10% increase over 1955 with 367 million cu. m. of gas sold to municipalities and industry.

Benzole products derived from the gas totalled 21,000 tons in 1956; production this year is expected to reach 25,000 tons. Nitrogen production reached 150,800 tons and the Mines' ammonia factory has been extended.

Altogether the nitrogen production per unit was now the third largest in Europe, the N.S.M. announced. It is hoped to open a polythene works at the end of 1958.

JAPAN

Synthetic rubber

The Japan Rubber Manufacturers' Association stated recently that the Japanese government had decided in favour of a plan for establishing a semi-official company to start synthetic rubber production by 1959.

The Association said the cabinet ministers concerned had agreed to allow the Japan Development Bank, a semi-official corporation, to supply most of the funds required for the project, estimated at 12,380 million yen.

Under the present plan the semi-official company is to produce 30,000

The Leonard Hill Technical Group—May

Articles appearing in some of our associate journals this month include:

Automation Progress—The Work of an Automation Consultant; A General-Purpose Analogue Computer; Chromatography; Data Processing Controls Manufacture; Force Balance Methods Integrate Process Control; Digital Control of Weighing; Automatic Feed and Transfer for Resistance Welding Machine; A Teaching Machine for Radar Training; Electronic Balancing of Rotary Machines; Automatic Gauging of Small Components.

Petroleum—Modern Techniques with Finished Products; Mechanical Handling of Stores; Modern Packaging; Container Research; Aerosol Packaging; The Search for Oil in Turkey.

World Crops—Jungle Clearance and Reclamation; The Engineer to the Rescue; Sprinkler Irrigation; Water for the Crops of South Africa; Irrigation of Agricultural Lands with Water from Deep Wells.

Manufacturing Chemist—Review of Industrial Instruments; Instrumentation; Surface Activity Congress; Synthetic Analgesics and Antagonists, 1; Progress Reports.

Paint Manufacture—Mechanical Handling in the Paint Industry; Automatic Filling; Fluid Handling; Mechanical Equipment for Producing Natural Pigments.

Dairy Engineering—Rider Electric Vehicles for Delivering Dairy Products; Production of Orange and Other Beverages by the Dairyman, 2; Research on Foil for Dairy Use; A New Crate-Stacking Machine; A Novel Bottle-Washing Installation in Holland; Care and Maintenance of Electric Motors in Dairies.

Atomics—Harwell's Research Reactors; Reactor Material Problems; Polonium—The Neglected Element; India's Nuclear Programme; The Story of Hermes; Reactor Monitoring; Nuclear Instrumentation.



DRAWING OFFICES EXTENDED

An indication of the rate at which Britain's chemical engineering industry has expanded in recent years is afforded by the news that W. J. Fraser & Co. Ltd., chemical engineering contractors, who have recently added a new wing to their design and engineering offices at Harold Hill, Romford, Essex, now employ nearly twice as many draughtsmen and designers as in 1953, when the offices were built. The extended drawing offices in the main building are shown above.

tons of synthetic rubber, including 27,000 tons of GR-S and 3,000 tons of latex in 1959. Its annual output would gradually increase to reach 45,000 tons in 1962.

Acrylonitrile production

The Mitsubishi Chemical Industry Co. is planning to start the production of acrylonitrile, with technical assistance from the United States. A monthly production of 600 tons is expected.

Facilities for producing hydrocyanic acid from mine gas by the Andrussov process will also be installed. The expected production is 500 tons/month.

The facilities will be installed in the company's Kurosaki plant in Fukuoka, western Japan, at a cost of 1,800 million to 2,000 million yen. The company said that, under the present plan, it is expected to begin operations in September 1958.

The Mitsubishi Rayon Co. is reported to be planning a technical tie-up with the Chemstrand Corporation of the United States to undertake the manufacture of *Acrlan*.

PANAMA

Petroleum refinery

The Panama Refining Co. (Refineria Panama S.A.) announced that plans for the new petroleum refinery would

be ready by the end of April, and that preliminary construction work and site preparation will be completed during the coming dry season.

In the 1958 dry season the refinery itself is to be constructed together with the storage tank area, residential area and wharves. The harbour will be a protective deep-water harbour and both tankers and cargo ships will be able to discharge their cargoes direct on to Panamanian territory. Another benefit from the refinery will be the local production of chemicals for agriculture and the manufacture of plastics from its by-products.

WESTERN GERMANY

New phthalic acid plant

A new plant to produce phthalic acid (mainly for the manufacture of plastics) came into operation at Bochum recently. Designed to produce 1,000 tons p.a., the plant is at present operating at about two-thirds capacity. There are already a number of concerns manufacturing phthalic acid in Western Germany, but they are unable to satisfy all German requirements. Output last year was estimated at nearly 30,000 tons.

The new plant is owned by the Gelsenkirchener Bergwerks A.G. and the Badische Anilin-und Sodafabrik (B.A.S.F.) and has been erected on

the site of the Chemische Werke Carolinenglück, Bochum, in order to take advantage of the naphthalene produced as a by-product by the latter firm in its coking and coal-tar installation. The Chemische Werke Carolinenglück is a subsidiary of the Gelsenkirchener Bergwerks A.G.

Chemical exports

West German exports of chemical products rose to D.M. 3,900 million last year, about 15% more than in 1955, according to final figures issued by the Association of the West German Chemical Industry.

The rate of increase was about the same as that from 1954 to 1955, the association said. Producers of chemical goods maintained the second place among West German export industries with shipments accounting for about 25% of their total sales.

Organic and inorganic industrial chemicals exports again accounted for the largest proportion of the overall chemical exports. They rose by D.M. 64 million to D.M. 919 million last year.

UNITED STATES

New hydrocarbon oxidation process

The Amoco Chemicals Corporation is to start engineering and construction immediately on a chemical plant which will use a new, unique, hydrocarbon oxidation process. The new plant will be built on a site of about 400 acres near Joliet, Illinois, on the Des Plaines River.

The hydrocarbon process enables production of a diversified line of chemicals at a single plant from one source, using petroleum raw materials. Standard Oil Co. (Indiana), parent of Amoco Chemicals, holds worldwide exclusive rights to the process and will supply the raw materials, mixed xylenes.

The new plant, with a capacity of about 60 million lb. p.a., will produce phthalic anhydride, isophthalic acid, terephthalic acid, dimethyl terephthalate, dimethyl isophthalate and benzoic acid.

Government grain for alcohol butadiene production

A plan to utilise 100 million bushels of government grain annually to produce alcohol and butadiene for domestic consumption has been outlined to the Senate Banking Committee, according to published reports.

The plan was proposed by the Bipartisan Commission on Increased Industrial Use of Agricultural Products, appointed by the President. It

calls for capacity operation of ten industrial fermentation alcohol plants and two government alcohol butadiene plants for a 12- to 24-month period to determine what a long-range programme would cost.

The plan also covers the proposal of Publicker Industries to process 20 to 50 million bushels of maize annually if the government will sell at a price in the neighbourhood of 60 cents a bushel. Publicker would export all its production; the Farm Commission, however, said that there was room in the domestic economy for all of the alcohol and butadiene produced from 100 million bushels of surplus grains yearly.

Some 30 million bushels, it is estimated, could go into industrial alcohol until recently supplied by imported blackstrap molasses. Another 70 million bushels could go to the manufacture of butadiene for sale to the producers of synthetic rubber, plants and plastics.

The commission estimated it would require 67,900,000 bushels of grain

a year to produce butadiene at capacity: 84,000 tons at the now idle Louisville, Kentucky, plant and 112,000 tons at the inactive Koppers Co. plant at Kobuta, Pennsylvania, both to be reactivated under the farm surplus proposal.

Sulphur expansion

A large expansion in Canada is being planned by the Jefferson Lake Sulphur Co., of New Orleans. The company will operate on properties of the Socony Mobil Oil Co. Inc. in Canada, comprising nearly 80,000 acres.

The Socony organisation had leased the Canadian properties as a gas producer, but found the gas was 'sour' or heavy with sulphur. Socony, therefore, made an agreement with Jefferson Lake for extraction of the sulphur.

Light foam plastic

According to a despatch in the *Wall Street Journal*, a new process bringing the cost of polyurethane (light foam

plastic) below that of foam rubber has been developed by Mobay Chemical Co.

Mobay, jointly owned by Monsanto Chemical and Farbenfabriken Bayer A.G., of Germany, informed its 14 licensees that materials for making this new low-cost form of polyurethane are now available.

The new process substitutes polyethers made from propylene glycol, selling for 25 cents/lb. in tank-car quantities, for polyesters, costing 50 cents/lb. as the ingredient making up 70 to 80% of the volume of the plastic.

One producer reports that this switch drops the cost of manufacturing polyurethane foam 25% below that of an equal volume of foam rubber.

Commercial production of methyl butynol

Methyl butynol, a tertiary acetylenic alcohol used in the perfume, pharmaceutical and chemical industries, will move into commercial, continuous-process production for the first time in the U.S. by the end of the year, it

COMPANY NEWS

Birwelco Ltd., of Aston, Birmingham, British manufacturing licensees for Petro-Chem *Iso-Flow* fluid heating furnaces, have been awarded a contract for the supply of equipment to be used in Esso's butadiene plant at Fawley. The largest unit will consist of a specially designed furnace with a heat release of 192 million B.Th.U./hr. Standing 180 ft. high, the heater will be the largest Petro-Chem *Iso-Flow* furnace in use in the British Isles.

Included in the contract are three smaller heaters and a quantity of heat exchange equipment to be supplied by Birwelco's associate company, Brown Fintube Great Britain Ltd. The value of the contract is approximately £250,000. Foster Wheeler Ltd. are responsible for the engineering and construction of the butadiene plant.

*

The Tube Investments Ltd. subsidiary, Mange Plastics Ltd., with works in Fulham, London, will shortly open a new factory at Aston, Birmingham, where the major part of its production will be centred. The new works will treble the company's capacity, and provide facilities for the manufacture of a recently developed range of fittings for plastic tubing.

Mange Plastics, backed by research

and development teams at TI's science and technological centres, is at present mainly concerned with the manufacture of TI polythene tubing for domestic and industrial plumbing and agriculture. It also specialises in the fabrication of welded plastic pipe structures for conveying corrosive liquids and gases.

*

Refinery gases are to be piped 17 miles from the Esso Petroleum Co.'s Fawley refinery to the Southampton works of the Southern Gas Board where they will be reformed for use as town gas. The contract to build the reforming plant has been awarded to Humphreys & Glasgow Ltd.

The installation will comprise two sets of Onia-Gegi catalytic plant, each of which will be capable of producing 8 million cu.ft./day of town gas, including cold enrichment, when reforming the refinery gases. Alternatively the plant can be used to gasify heavy oil, in which case each set will have a capacity of 4 million cu.ft./day. The plant is expected to be put into operation during the summer of next year.

Humphreys & Glasgow Ltd., have also been awarded a contract by the Northern Gas Board for the installa-

tion of two sets of Onia-Gegi regenerative plant for the gasification of heavy oil at the Newcastle Redheugh gasworks. Each of these sets will have a rated output of 3 million cu.ft./day of town gas.

*

Brunei Shell Petroleum Co. Ltd., the new Shell Group company registered in Brunei at the beginning of this year, is now working on its own account and the British Malayan Petroleum Co. Ltd., registered in the United Kingdom, will go into liquidation. In effect operations will continue unchanged.

During 1957 Brunei Shell has budgeted to spend about £3½ million on its exploration and drilling programmes and a further £2 million on capital construction.

*

Chamberlain Industries Ltd., mechanical engineers and manufacturers of *Staffa* bending machines and hydraulic equipment, report that they have appointed Electricals, Ltd., 14 Claremont Place, Newcastle-upon-Tyne 2, as sole agents for the sale of the small hand and motorised bending machines up to 4-in. capacity, in Westmorland, Durham, Northumberland, Cumberland and Teeside.

has been announced by the Air Reduction Co. A plant with annual capacity of 3 million lb. will be built at Calvert City, Kentucky.

The process, developed by Air Reduction, involves the reaction of acetylene and acetone using a basic catalyst. Both methyl butynol and methyl pentynol (also to be produced) retain the triple bond of the parent acetylene but are themselves completely stable and therefore present no handling and storage problems, the announcement said.

BELGIUM

Fatty acids manufacture

The Archer-Daniels Midland Co., of Minneapolis, U.S., is to manufacture fatty acids and by-products in Belgium, in conjunction with Palmatina (a subsidiary of Petrofina). A new company, Oléochin S.A., has been constituted for this purpose and it is proposed to build a factory at Ertvelde (east Flanders) estimated to cost B.Fr. 100 million. Production is scheduled to begin at the end of 1958 and, when the plant is in full operation, it will supply not only Belgium but other European and Middle East countries.

SPAIN

Aluminium oxide deposits

New deposits of aluminium oxide have been discovered in Lower Aragon near the villages of Belmonte and La Carollera. It is claimed that the mineral extracted contains 48% alumina.

THAILAND

Chemical plants to be established

A three-year plan for the establishment of chemical plants at a cost of Baht 150 million, with a view to conserving foreign exchange and ensuring supplies in time of emergency, has been announced. The programme envisages a daily production of 25 tons of sodium carbonate, 5 tons caustic soda, 32 tons ammonium chloride, 12 tons ammonia, 2 tons nitric acid, 48 tons nitrogen fertiliser, 10 tons sulphuric acid, 1½ tons hydrochloric acid and 1 ton sodium sulphate as being materials essential to industries producing soaps, detergents, textiles, glass, paper pulp, steel, enamelware, explosives etc.

The necessary raw materials, it is believed, are obtainable from the country's own resources, e.g. salt, limestone and sulphur. The plants would be sited in Bangkok. No capital appropriation for the purpose appeared in the 1957 budget, however.

SOUTH KOREA

Fertiliser plant

The South Korean government and three leading West German companies have reached an agreement on the construction of a urea fertiliser plant costing \$U.S.20,700,000.

The plant, which is expected to be completed by April 1960, will produce about 89,000 tons p.a. of urea, about a quarter of the total nitrogenous fertiliser requirements of South Korea. The construction of the plant at Naju, south-western Korea, at the heart of Korea's 'rice bowl,' will begin early next year.

Under the agreement, the West German firm of Lurgi will handle the chemical and technical side of the plant construction, with Demag supplying the machinery. Siemens will be responsible for the construction of a steam-turbine power plant for the fertiliser plant. A team of six German

technicians have completed the basic survey for the construction.

The German firms will also make an investment of \$U.S.5 million to explore 10 South Korean mines, mostly owned by the government. Ores from the mines will be sold in the foreign markets which in turn will be used to repay the German loan.

SWEDEN

Sulphate factory

Output capacity of the proposed new sulphate factory of the Swedish Forestry Owners Cellulose Co. at Münsteras, on the south Baltic coast, will be 70,000 tons p.a. of unbleached sulphate pulp, of which about half will be further processed by bleaching. The plant is being built to utilise the surplus of sulphate wood in southern Sweden which has been difficult to dispose of in recent years.

INDUSTRY REPORTS . . .

Iranian oil

Iran received over £54,300,000 in oil revenues for last year from the operations being carried out in the southern part of the country under the terms of the 1954 oil agreement.

This fact is included in a report for 1956 released by the Iranian Oil Exploration & Producing Co. and the Iranian Oil Refining Co., which were formed by the international group of 17 oil companies known as the Consortium, to operate the oil installations in southern Iran.

The report states that the search for new oil reserves in the 100,000

sq. m. of the agreement area was resumed in 1956. Crude oil production amounted to 25,934,000 tons compared with 15,772,000 tons in 1955, and in the particular yearly period specified in the agreement (January 29, 1956, to January 28, 1957) was 9.7% in excess of the guaranteed quantities.

Increased expenditure on Canadian construction

Expenditures for new construction by Shawinigan Chemicals Ltd. (Canada) totalled \$4,733,000 compared with \$1,098,000 in 1955. Included were construction of a new rotating-hearth carbide furnace now in operation in Shawinigan Falls which has increased production of the company's basic material, calcium carbide, by about 12%; completion of additions to the vinyl acetate plant; construction of a sulphuric acid plant; initial construction of a caustic soda and chlorine plant; and development work on a new plant site in Shawinigan East where the sulphuric acid and caustic soda and chlorine plants are located.

Synthesis gas and crystalliser plants

The chemical plant division of the Power-Gas Corporation Ltd. (Britain) is currently concerned with a number of projects at home and overseas, including, in particular, synthesis gas plant for the production of nitrogen fertilisers. In the statement of the



chairman, circulated with the annual report and accounts, it was pointed out that the corporation's opportunities in large-scale chemical engineering are continually being widened and supplemented by licences to use processes developed by others; a recent example being the *Texaco* partial oxidation process for the production of gases used in the chemical industry.

The chemical plant division's *Krystal* crystalliser business is now established to cover many countries of the world. During 1956, five plants were built and contracts were received for three more, including a 900-ton/day ammonium sulphate crystalliser plant in Italy. The division's first sulphuric acid plant to Chemiebau Zieren design has successfully passed its demonstration tests. Two plants for the production of pure hydrogen from propane and butane gases are under construction and three plants employing the *Girbotol* process are nearing completion.

Ceramics research and development

In his circulated statement to the shareholders of Doulton & Co. Ltd. (Britain), Mr. E. Basil Green, chairman and managing director of the company, stated that modern technical developments are now so rapid that the company has decided to set up a central research and development branch which will investigate problems submitted by the production units and also pursue general research not only in ceramics but also into new and competing materials likely to be of interest to the group.

Increase in nickel production

The International Nickel Co. of Canada Ltd. in 1956 achieved new records in earnings and ore production, and launched a major project in Manitoba for the development of what is expected to become the world's second largest nickel mining operation, according to the annual report.

International Nickel's facilities for producing primary metals were operated in 1956 to the limit of capacity for the seventh successive year. Total ore mined amounted to 15,511,000 tons, compared with 14,248,000 tons in 1955.

Deliveries of nickel in all forms in 1956 amounted to 286 million lb. Copper deliveries were 271 million lb. Other deliveries included 371,000 oz. of platinum metals and, for the first time, pellets from the new iron ore recovery plant near Copper Cliff. Net sales were \$444,740,000, compared with \$416,323,000 in 1955.

Methanol production record

The production and sale of methanol by the Commercial Solvents Corporation (U.S.) attained record levels in 1956. At the end of the year construction of additional facilities for this major product was under way at Sterlington, Louisiana. The company's programme for the expanded conversion of methanol is being furthered with the building of a new chemical derivatives unit at Terre Haut, Indiana. Both expansions are scheduled for completion later this year.

An affiliated company, Northwest Nitro-Chemicals Ltd., occupies a new plant at Medicine Hat, Alberta, Canada, where ammonium nitrate, ammonium phosphate, and ammonium phosphate-sulphate fertilisers are being produced.

Twenty-fold increase in exports

The chairman of Marchon Products Ltd. (Britain), Mr. Frank Schon, has announced that his company's exports are now 20 times greater than they were in 1950. The share of exports of the total sales has increased steadily in the past seven years, rising from 14.3% in 1950 to 52.7% last year. During the same period, the company's total turnover increased by more than five times.

Mr. Schon believes that this achievement, in a highly competitive market, was attained by frequent visits to most parts of the world by senior executives, by careful study of what the buyer

wants, and by prompt delivery of the right goods at the right price. Marchon Products Ltd. are a member of the Albright & Wilson group of companies.

Expansion in chemical operations

As a measure of the growth and diversification of the chemical division of Celanese Corporation of America, the annual report cites the fact that approximately 40% of its current sales volume comes from products introduced since 1949. Recent developments include the expansion under way in the company's Bishop, Texas, plant which will increase by 25% its output of formaldehyde, methanol, acetaldehyde and certain other organic chemicals. When in full operation later in 1957, the Bishop plant will be the world's largest producer of formaldehyde and the only commercial plant using the direct oxidation process in its production.

Carbon black

In his circulated statement for the year ended November 30, 1956, the chairman of the Anchor Chemical Co. Ltd. (Britain), pointing out that carbon black of many kinds continues to be a very important raw material in the rubber and allied trades, commented that the general-purpose furnace type, made in Swansea, is slowly but surely being accepted by industry. Furthermore, good progress has been made with plans to produce at Swansea the more popular grades used today.

MEETINGS

Society of Chemical Industry

Chemical Engineering Group

May 14. 'Some New Chemical and Physical Aspects of Polyester Resin Technology,' by L. H. Vaughan, 5.30 p.m., 14 Belgrave Square, London, S.W.1.

Chemical Society

May 9. 'Structural Evidence regarding the Solid Addition-compounds of Ethers and Amines with Halogens and other Molecules acting as Electron Acceptors,' by Prof. O. Hassel, 7.30 p.m., Burlington House, W.1. Centenary Lecture.

May 13. 'Chemical Evolution,' by Prof. J. D. Bernal, 5.15 p.m., Lecture Room 239, University Science Laboratories, South Road, Durham.

May 17. 'Reduction by Metal-

Ammonia Solutions,' by Prof. A. J. Birch, 5 p.m., Washington Singer Laboratories, Prince of Wales Road, Exeter.

Incorporated Plant Engineers

May 7. 'Contemporary Plant Engineering in the U.S.A.,' by H. M. Sylvester, 7 p.m., Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2.

May 9. 'Developments in Boiler Feedwater Treatment,' by J. S. Couper, 7.15 p.m., Scottish Building Centre, 425-427 Sauchiehall Street, Glasgow.

Society of Instrument Technology

May 14. 'Industrial Application of Radio Isotopes,' by H. A. Tapsfield, 7.30 p.m., Manchester College of Technology.

